"EVALUATION OF SMILE ESTHETICS USING DIMENSIONAL ANALYSIS – AN IN VIVO STUDY."

Dissertation submitted to

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

In partial fulfillment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH V

DEPARTMENT OF ORTHODONTICS AND DENTOFACIAL ORTHOPEDICS

2015-2018

CERTIFICATE

This is to certify that the dissertation titled **"AN EVALUATION OF SMILE ESTHETICS USING DIMENSIONAL ANALYSIS – AN IN VIVO STUDY"** is a bonafide work done by **DR. NEERAJA KURUP** under my guidance during her postgraduate study period between 2015 – 2018.

This dissertation is submitted to **THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY**, in partial fulfillment for the degree of Master of Dental Surgery in Branch V- Orthodontics and Dentofacial Orthopedics.

It has not been submitted (partially or fully) for the award of any other degree or diploma.

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CONTENTS

INTRODUCTION

INTRODUCTION

Face depicts the overall attractiveness of an individual in which smile forms a fundamental role[1]. A Smile is an individual's ability to express their emotion and is the sum of many attributes[2]. The value of an attractive smile is indubitable. A smile is considered the universal friendly gesture in all cultures. An attractive smile in modern society is often considered an asset in interviews, work settings and social interactions[3]. Smile esthetics has become a primary concern for patients and orthodontists, because it is a primary reason for which patients seek orthodontic treatment[4].

Social perception of esthetics is the most valuable tool for assessing overall facial attractiveness. Facial attractiveness is best defined by an attractive smile. Hence achieving the best smile has often been very challenging for Orthodontists[5]. An esthetic smile is a result of various components acting in unison with perfect balance of musculature and teeth. Therefore establishing ideal esthetics may be obstinate and requires tedious planning[6]. A number of variables affects the attractiveness of smile which in turn influences the overall facial attractiveness[7]. Various authors have contributed to the field of smile esthetics, however very few emphasizes the importance of smile in all three planes of space[8].

The subjectivity of beauty makes it difficult to establish clear cut esthetic goals for diagnosis and treatment planning. It is often possible to formulate guidelines to optimize dentofacial esthetics while still satisfying other goals[9]. Major arena of research interest in terms of smile esthetics have been confined to analysis of various attributes of smile in frontal view. To

our knowledge, no studies has considered the difference in perception of smile esthetics from frontal and profile view shot simultaneously. This factor is addressed in this study.

Havens et al[10] reported that tooth alignment is a more important factor than the eyes for evaluating facial esthetics. Therefore, contemporary orthodontists must consider esthetic smiles by managing the dentition and soft tissues. In clinical orthodontics, patient-driven esthetic diagnosis and treatment planning have become important. Thus, smile analysis has become an essential element of diagnosis and treatment planning. The necessity to conduct this study is to find a correlation, if any between subjective and objective assessments of smile. In order to record the posed smile from frontal and profile view, digital cameras were used which were placed at right angles to each other a fixed predetermined distance from the sample. [11]

Hence the **aim** of this study was to evaluate smile esthetics in all three planes of space and to relate it to overall facial attractiveness. The uniqueness of this study is the use of two digital cameras for recording smile simultaneously from frontal and profile view. Subjective and objective assessment of posed smile are done on the samples.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

B. L Herzberg et al(1952)[12] made an effort to show definite landmarks or features to be examined in faces so that treatment may be planned accordingly with the thought in mind of not distorting favorable facial esthetics and of improving poorly balanced faces. He states that not only does the orthodontist align teeth, but he can and does frequently improve the functional values of denture, the health of the teeth and soft tissues and created harmony of facial features where disharmony and imbalance previously existed. The role of orthodontists is not to make the tooth straighter, but rather that of the dentofacial orthopedist.

Harvey Peck and Sheldon Peck et al (1970)[13] reviewed many refined concepts of facial esthetics from ancient Egypt through the Renaissance and Western civilization recorded in sculpture. They mentioned that society today possess ideals of facial esthetics and the disciplines of psychology and sociology helps in identifying popular esthetic preferences. It was also stated that the orthodontic community has neglected to study the publics esthetic view point.

Ernst K. Janzen et al (1977)[14]states that the primary treatment goal in orthodontics is to produce a well-balanced functional occlusion. However, a well-balanced smile is an additional, most important treatment objective. A proper evaluation of facial esthetics requires careful clinical inspection of the patients smile before treatment commences. The ultimate position of anterior teeth has a great influence on the relationship of the lips to each other and to the surrounding and underlying facial structures. The teeth should be moved with one mode of movement in a direct vector line, avoiding “round tripping” as much as possible. Improved facial balance during smiling is an essential treatment objective and adds an important dimension to successful orthodontic treatment.

T.G. Matthews et al (1978)[15] stated that the anatomy of the smile is an integral part of dentistry. Its understanding involves close scrutiny of all elements of the oral region. It is not enough to establish the size of teeth based on the high and low lip lines, size of the mouth, and a shade to blend with the age and complexion. To create a harmonious smile the dentist must maintain or create the normal curvature of the lips, proper exposure of the red zone of the lips, an undistorted philtrum, and undisturbed nasolabial grooves. These entities, maintained in harmony with the exposed teeth, constitute the anatomy of a smile.

Sheldon Peck et al (1992)[16] stated that the biological mechanism underlying gingival smile line appears to include the combined effects of several variables like anterior maxillary excess of 2 – 3 mm additionally, greater muscular capacity to raise the upper lip on smiling and supplemental associated factors, including excessive overjet, excessive interlabial gap at rest and excessive overbite.

Ronald J. Mackley et al (1992)[17] stated that a profile photo is not a reliable source of information to determine what a person's actual smile looks like. To maximize the potential for improving smile, one must include into treatment plan, an objective to move the anterior teeth vertically to improve their relationship to smiling lip line.

Julie C. Faure et al (2002)[18] evaluated the effect of facial symmetry and inter-ocular distance on the assessment of facial aesthetics, factors that are often suggested as major contributors to facial aesthetics and concluded that symmetry and inter ocular enlargement had a negative effect on facial esthetics.

Marc B. Ackerman and James L. Ackerman et al (2002)[19] stated that smile analysis and smile design generally involve a compromise between two factors that are often contradictory: the esthetic desires of the patient and orthodontist, and the patient's anatomic and physiologic

limitations. Using digital video and technology, the practitioner can evaluate the patient's dynamic anterior tooth display and incorporate smile analysis into routine day practice. Esthetic smile design is a multifactorial decision-making process that allows the clinician to treat patients with an individualized, interdisciplinary approach.

Orlagh Hunt et al (2002)[20] found that the attractiveness of a person's smile is influenced by the amount of maxillary gingival exposure. More attractive ratings were awarded to those smiles where the amount of gingival exposure was within the range of 0–2 mm.

David M. Sarver and Marc B.Ackerman et al (2003)[21] stated that the "art of the smile" lies in the clinician's ability to recognize the positive elements of beauty in each patient and to create a strategy to enhance the attributes that fall outside the parameters of the prevailing esthetic concept. New technologies have enhanced our ability to see patients better and had facilitated the quantification and interaction of newer concepts of function and appearance. Visualization and quantification of the dynamics of the smile is a 2-stage process. The first crucial step is the clinical examination. The key element in this evaluation is the direct measurement of lip–tooth relationships both dynamically and in repose. Record taking is the second step in this process.

David M. Sarver and Marc B.Ackerman et al (2003)[22] discussed a comprehensive methodology for recording, assessing, and planning treatment of the smile in 4 dimensions. Orthodontic history, beginning with Angle and Wuerpel, has taught us that the "art of the smile" lies in the clinician's ability to recognize the positive elements of beauty in each patient and then create a strategy to enhance the attributes that fall outside the parameters of the prevailing esthetic concept. The difference between contemporary orthodontic practice and that of our predecessors is that we now can dynamically visualize and quantify our patients' smiles. Orthodontic diagnosis has, in a certain sense, come full circle.

Jenny R. Maple et al (2005)[28] evaluated the perception of facial attractiveness in profile digital photographs that were incrementally altered to produce different combinations of mandibular anteroposterior positions and lower anterior facial heights. Interactions of the anteroposterior and vertical dimensions and the magnitude of these changes in each dimension influence the perception of facial attractiveness; the more extreme deviations that result in the vertical dimension accentuating the horizontal dimension toward an extreme Class II or Class III were scored as the least attractive.

Roy Sabri et al (2005)[23] stated that an optimal smile is characterized by an upper lip that reaches the marginal ginigiva, with an up or straight curvature between the philtrum and commissures; an upper incisal line which is coincident with the border of the lower lip; minimal or no lateral negative space; a commissural line and occlusal frontal plane parallel to the pupillary line; and pleasantly integrated dental and gingival components. These concepts of smile esthetics are not new, but are too often overlooked in orthodontic treatment planning. The eight components of the smile should be considered not as rigid boundaries, but as artistic guidelines to help orthodontists treat individual patients who are today, more than ever, highly aware of smile esthetics.

Steven J. Lindauer et al (2005)[24] had studied the effects of two common procedures used to correct deep overbite due to the assumption that overbite correction, specifically maxillary incisor intrusion, will lead to smile arc flattening and consequently reduce smile attractiveness. The results of their study suggested that straightening of the smile arc is a common occurrence during orthodontic treatment and not necessarily related to maxillary incisor intrusion.

Theodore Moore et al (2005)[26] stated that having minimal buccal corridors is a preferred esthetic feature in both men and women, and large buccal corridors should be included in the problem list during orthodontic diagnosis and treatment planning.

Erdal Isıksal et al (2006)[27] stated that subjects with ideal occlusions and Class I patients treated with or without extractions were not differentiated in smile esthetics by 6 panels of judges (orthodontists, plastic surgeons, artists, general dentists, dental professionals, and parents). Transverse characteristics of the smile appeared to be of little significance to an attractive smile. Maxillary gingival display and the ultimate positions of the anterior teeth have definite effects on smile esthetics. Treatment modality alone has no predictable effect on the overall esthetic assessment of a smile.

Sanjay Manhar Parekh et al (2006)[25] evaluated changes in attractiveness on the basis of computerized variations of smile arcs and buccal corridors for male and female smiles judged by orthodontists and laypersons. They concluded that both laypersons and orthodontists prefers smiles in which the smile arc was consonant and buccal corridors were minimal. Significantly lower attractiveness ratings were found for smiles with flat smile arcs and excessive buccal corridors.

Christopher Maulik and Ravindra Nanda et al (2007)[30] established dynamic norms for the smile and showed that orthodontic treatment might not flatten the smile arc as previously suggested, and, furthermore, that RME appears to be associated with a decreased buccal corridor.

Pieter A. A. M. van der Geld et al (2007)[29] stated that a reliable assessment of the smile line and tooth and gingival display during smiling and speech can be obtained with this digital videographic method. Moreover, this method is suitable for clinical practices. In view of the increasing esthetic demands of patients with regard to orthodontics, esthetic dentistry, and dental

surgery treatment, irreversible procedures in dentofacial esthetics should be undertaken only when adequate information is obtained regarding the smile and functional tooth display.

Pieter Van der Geld et al (2007)[31] stated that size of teeth, visibility of teeth, and upper lip position are critical factors in self-perception of smile attractiveness (social dimension). Tooth colour and exposure of ginigiva are considered critical factors in satisfying smile appearance (individual dimension). Smiles with disproportional gingival display are judged negatively and correlate with personality characteristics.

Laurie McNamara et al (2008)[33] stated that the vertical lip thickness proved to be the most influential variable in smile esthetics. The significant relationship of protrusion of incisors with the vertical thickness of the vermilion border of upper lip should be considered when planning orthodontic treatment.

Pieter Van der Geld et al (2008)[35] concluded that the upper premolars and first molar are part of the aesthetic zone in most patients. Lip – tooth relationships during spontaneous smiling, speech, and at rest follow a consistent pattern. The significant reduction in maxillary lip line heights with age should be taken into consideration in orthodontic treatment planning.

Roxanne Shafiee et al (2008)[32] stated that the clinician judges demonstrated a high level of agreement in ranking the facial attractiveness of profile, full-face, and smiling photographs of a group of orthodontically treated patients whose actual differences in physical dimensions were relatively small. The judges' rankings of the smiling photographs were significantly better predictors of their rankings of the triplet of each patient than were their rankings of the profile photographs.

Vinod Krishnan et al (2008)[34] stated that smile analysis should be an important aspect of orthodontic diagnosis and treatment planning. Orthodontists should not disturb consonant smiles but create them with proper bracket positioning.

Brian J. Schabel et al (2009)[40] analyzed if any correlations could be found between subjective evaluations of posttreatment smiles captured with clinical photography and rated by a panel of orthodontists and parents of orthodontic patients, and objective evaluations of the same smiles from the Smile Mesh program and concluded that no objective measure of the smile could predict attractive or unattractive smiles as judged subjectively.

Brian J. Schabel et al (2009)[39] stated that the Q-sort was more reliable than the VAS for measuring smile esthetics. Orthodontists and parents of orthodontic patients agreed with respect to grading of “attractive” and “unattractive” smiles. Laymen had less acceptance with respect to “attractive” and “unattractive” smiles.

Caroline de Deus Tupinamba´ Rodrigues et al (2009)[38] stated that the absence of variations from beauty norms of a smile has a positive impact on its esthetic perception, but variations from the norms do not necessarily result in reduced attractiveness.

Hideki Ioi et al (2009)[37] had modified the buccal corridor to judge the effects of buccal corridors on the smile attractiveness between the male and female raters for both the orthodontists and dental students and concluded that both the orthodontists and dental students preferred broader smiles to medium or narrow smiles.

Shyam Desai et al (2009)[36] established the age-related dynamic norms. As an individual ages, the smile gets narrower in the vertical and transverse dimension. This dynamically measures the muscles ability to create a smile that decreases with an increase in age.

Brian J. Schabel et al (2010)[42] found that a positive correlation was noted between the measurements obtained from smiles captured by clinical photography and those captured with digital video clips. Hence he concluded that a standard digital photograph appears to be a valid tool for analyzing the posttreatment smile.

David C. Havens et al (2010)[46] stated that the presence of a malocclusion has a negative impact on facial attractiveness. Orthodontic correction of a malocclusion affects overall facial esthetics positively. Laypersons and orthodontists agree on attractiveness ratings. Overall facial balance is the most important factor used in deciding facial attractiveness.

Elaine Brough et al (2010)[41] stated that the morphology, size, and shade of the maxillary canine in patients having orthodontic space closure and lateral incisor substitution can have a marked effect on perceived smile attractiveness.

Elham S. J. Abu Alhaija et al (2010)[49] showed that profession and gender affected buccal corridor spaces (BCS) and midline diastema attractiveness ratings. Wide BCSs, a gingival display of more than 2 mm, and the presence of a midline diastema of any size were rated as unattractive by all groups.

Federica Verdecchia et al (2010)[48] investigate whether anterior dental alignment in 8- to 10-yr old children influences the first impressions of their peers, and to verify the validity of the tested method. The results demonstrated that the usage of a questionnaire was reliable tool both from an internal coherence standpoint and from a test–retest reliability perspective. When evaluating information regarding the five areas of interest, it could be seen that 8- to 10-year-olds viewed their peers with well-aligned teeth more propitiously as far as honesty, personal happiness, and intelligence were concerned. However, there was no statistically significant difference with

regard to pleasantness and extroversion in children with harmonious, as opposed to crowded or proclined anterior teeth.

Goutam Chakroborty et al (2010)[43] aimed to determine the role of gingival component in designing a smile and concluded that different factors of central zone of smile have fair to good correlation with lip dynamics as assessed by smile index.

Mohan Bhuvaneswaran et al (2010)[45] provided an organized and systematic approach is required to evaluate, diagnose and resolve esthetic problems predictably. It is of prime importance that the final result is not dependent only on the looks alone. The ultimate goal as orthodontists is to achieve pleasing constitution in the smile framework by creating an arrangement of various esthetic elements.

Nathalie Ghaleb et al (2010)[44] stated that upper incisor inclination affects smile aesthetics in the profile view. There is significant interaction effect between appreciation of incisor inclination and the judge's profession. Incisor inclination above normal standard values was preferred by all panels for optimum smile aesthetics. In the aesthetic photographic position, the preferred incisor is angulated 93 degrees to the horizontal line and +7 degrees to the lower facial third. Orthodontists tend to prefer labial crown torque in comparison with lingual crown inclination.

Sarah H. Abu Arqoub et al (2010)[47] studied the influence of altering antero-posterior (AP) and vertical proportions of the lower face and its effects on rankings for facial attractiveness. A Class I profile of males with a normal lower face height and Class I profile of females with a reduced lower face height were ranked as most attractive. Class II male and female profiles with increased lower face heights were ranked as least attractive. As the vertical and AP dimensions diverged from normal, attractiveness decreased. Images with Class II profile and increased lower

face heights were considered less attractive than corresponding images with Class III profile and reduced lower anterior facial heights. Gender had a limited influence on the perception of attractiveness. A difference in perception of profile attractiveness was found between dentists and lay people.

Ana B. Macías Gago et al (2011)[52] designed a study to determine if the faces considered more beautiful in a young population exhibit the same parameters used by orthodontists to assess successful results. The findings show that the faces considered more attractive fulfilled the cephalometric and facial norms.

Catherine McLeod et al (2011)[51] stated that individual perception of smile esthetics influenced by national/cultural background can affect multiple variables in unequal ways and must be considered in research and clinical settings.

Guilherme Janson et al (2011)[55] stated that that smile attractiveness is similar in treatment protocols of one , three, and four premolar extractions and that widths of buccal and posterior corridors do not influence smile attractiveness in these groups.

Li Cao et al (2011)[50] stated that both maxillary incisor labiolingual inclination and AP position play an essential role in the esthetics of the smiling profile. However, when formulating treatment plans, dentists should never underestimate the labiolingual inclination's influence on the smiling profile.

Pieter Van der Geld et al (2011)[54] stated that smile line analysis can be performed reliably with a 3-grade scale (visual) semi quantitative estimation. For a more comprehensive diagnosis, another measuring tool is proposed, especially in patients whose gingiva is exposed disproportionately.

Sabrina Elisa Zange et al (2011)[53] determined the perception of orthodontists and laypersons regarding the size of the dark spaces in the buccal corridors and how that affects smile esthetics in individuals with long and short faces. The presence or absence of dark spaces in the buccal corridors has little influence over smile esthetics. Hence, while this aspect should be considered in the orthodontic diagnosis, there is no confirmation for expanding the buccal corridor to eliminate dark spaces unless they are extremely evident.

Hagai Miron et al (2012)[56] stated that in in subjects with a high smile pattern: (1) short upper lip length, (2) low smiling/resting upper lip length ratio, (3) inferior attachment of the upper labial vestibule, and (4) prominent upper lip vermilion was found.

Hrushikesh Aphale et al (2012)[1] presented the importance of smile characteristics in obtaining the desired results during orthodontic treatment. The characteristics of smile as a tool to orthodontic practice may aid in giving the dentist a successful clinical practice**.**

Angela I-Chun Lin et al (2013)[57] Smile esthetics increased with increased recruitment of muscles involved in smile production. The results were healthy across the subjects, suggesting that objective rating methods for assessing dynamic smile esthetics could become an important clinical tool.

Bhavna Singh et al (2013)[59] stated that with age, the smile gets narrower vertically, especially for the male population. The pattern of change observed in the present study must be considered and incorporated during treatment planning to deliver healthier and long-lasting results to patients of all age groups.

Burcak Kaya et al (2013)[58] stated that many factors affects smile attractiveness. However, the influence of the interaction of several factors is not as well known. Additionally, patients and clinicians might view smile esthetics differently. Examining other factors influencing the

perception of smile attractiveness might be of help to clinicians for developing more satisfying treatment plans for their patients.

Joan F. Walder et al (2013)[60] stated that esthetic considerations play an increasingly important role in patient care, and clinicians need a methodology that includes imaging techniques to capture the dynamic nature of the smile. Photographs of posed smile are used on a daily basis to help aid in diagnosis and treatment planning.

Anthony L. Maganzini et al (2014)[61] stated that smile esthetics is improved by orthodontic treatment regardless of the initial severity of the malocclusion. In other words, patients with complex orthodontic issues or their counterparts with minor issues benefitted equally from treatment in terms of their smile attractiveness.

Bruna Dieder Correa et al (2014)[62] stated that the perceptions of unilateral asymmetries in the gingival margin levels of the maxillary canines were 1.0 mm for orthodontists and 1.5 to 2.0 mm for laypersons.

Sercan Akyalcin et al (2014)[63] stated that a harmonious smile arc relationship and less gingival display during a smile are significantly associated with smile attractiveness in patients considered successfully treated according to ABO standards.

Enio Ribeiro Cotrim et al (2015)[64] had aimed to highlight differences in perception of smile esthetics by clinicians, orthodontists and laypeople and assessed factors such as lip thickness, smile height, color gradation, tooth size and crowding, and also other factors which are associated with smile unpleasantness. They concluded that the groups highlighted different characteristics associated with smile unpleasantness. Orthodontists preferred less gingival display, whereas laypeople highlighted disproportionately arranged teeth and clinicians preferred whiter teeth.

Kyoko Hata et al (2015)[65] had studied frontal posed smiles of 100 Japanese females after orthodontic treatment using a visual analogue scale (VAS). The photographs were ranked based on the VAS evaluations and 25 photographs with the highest evaluations were selected as group A, and the 25 photos with the lowest evaluations were designated group B. Then 12 dimensional items of objective analysis were measured; out of 7 parameters in transverse plane and 5 parameters in vertical plane. Means and standard deviations for measurements of the dimensional items were compared between the groups. It was found that significant differences were observed only in the vertical dimension, not in the transverse dimension. Dimensional diagnostic items were found to be correlated with subjective judgments of postorthodontic frontal smile attractiveness in Japanese female patients: interlabial gap, intervermillion distance, maxillary gingival display, maximum incisor exposure, and lower lip to incisor. All five items were in the vertical dimension only.

Machado RM et al (2016)[66] verified whether different levels of maxillary incisal edges exposure influenced the perception of smile esthetics and whether exposure of gingiva affects this perception among various groups of orthodontists, dentists, orthodontic patients, and laypersons. They concluded that most accepted vertical relationship of incisor edges was 1.0-mm step and that gingival exposure had a positive influence on smile attractiveness.

Chompunuch et al (2017)[67] stated that the age of an individual impacts the perception of smile based on gingival display in maxillary anterior region and the presence of a black triangles between the maxillary central incisors. Due to the dissimilarity in esthetic assessment of each person, participation of orthodontists and patients in the decision making and treatment planning is crucial to provide successful results.

MATERIALS AND METHODOLOGY

MATERIALS USED IN THE STUDY: (Fig 1 – 5)

1. Diagnostic Instruments – Mouth Mirror, Probe, Tweezer
2. Vivitar Tripod – 2
3. Canon DSLR 1200D Camera – 2
4. Measuring Tape - 1
5. Simplex Porta Light with 1000W halogen tube - 1
6. White Chart – 5
7. Smile DesignerPro Software
8. Microsoft Office Powerpoint 2013
9. Protractor
10. Metric Ruler

Figure 1 – Diagnostic instruments

Figure 2 – Metric ruler and Protractor

Figure 3 – Halogen light

Figure 4 Measuring tape

Figure 5 – Digital Camera mounted on Tripod

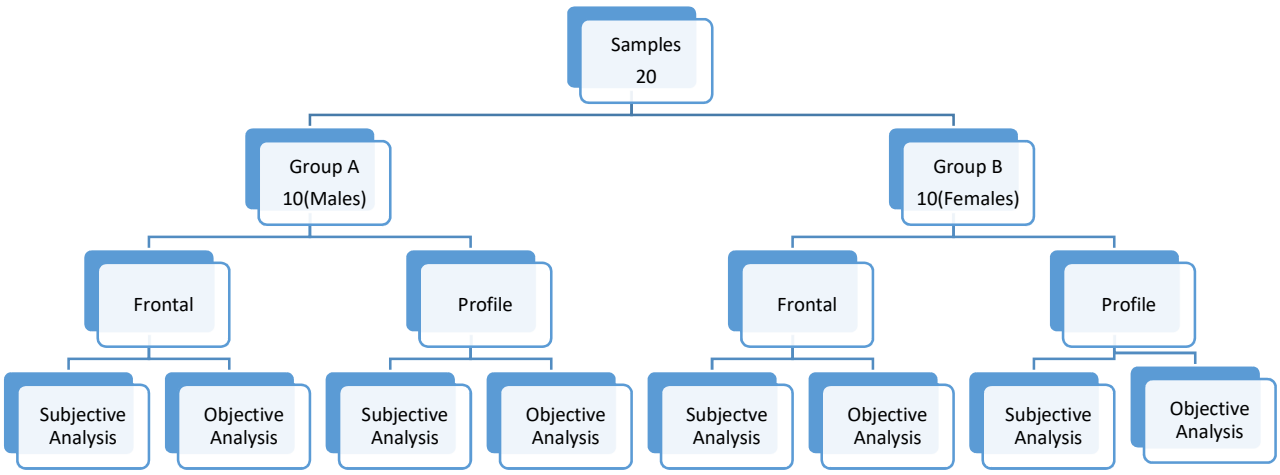
METHODOLOGY:

The **aim** of this study was to evaluate smile esthetics in all three planes of space and relate it to overall facial attractiveness. A total of 20 subjects (10 males, 10 females) were selected from Sri Ramakrishna Dental College and Hospital, Coimbatore, Tamil Nadu based on Index Of Orthodontic Treatment Needs (Dental Health Component : Grade 3).

Each subject reviewed and signed a consent form created in accordance with the rules and regulations of the Ethical Committee. The study was approved by the Ethical Committee of Sri Ramakrishna Dental College and Hospital, Coimbatore, Tamil Nadu.

DIVISION OF SAMPLES

The samples were divided equally into 2 groups based on gender as shown in the Figure.



SELECTION CRITERIA:

I. Inclusion Criteria;

1. Age group between 18-23 years
2. Untreated Patients classified on basis of Index of orthodontic treatment need (IOTN), dental health component Grade 3[12].

II. Exclusion Criteria;

1. Gross facial asymmetry
2. Previous orthodontically treated Patients
3. Unerupted or impacted supernumerary teeth
4. No active periodontal disease and no periodontal treatment except for routine scaling and root planing.

All the 20 subjects included in the study were selected based on the inclusion criteria and were undergraduate students from the institution with the age group between 18-23 years.

Two digital video cameras were used to record the posed smile of the subject in natural head position from the frontal and profile view at the same time. The cameras were placed at right angles to each other. The subjects were seated in natural head position with a distance of 3 feet from the camera lens. The cameras were mounted on a vivitar tripod, for recording the procedure and to prevent undesired operator movements depicted in Figure – 6.

A white background was standardized, before the video was recorded. Prior to the recording procedure, subjects were asked to rehearse the phrase “Chelsea eats cheesecake on the Chesapeake” for producing a relaxed posed smile[13]. The smile was recorded for a duration of 10 seconds. Subsequently the video was uploaded to GOM media player software and this program

allowed the streaming video to be converted individual photographic frames at the rate of approximately 30 frames per second[14]. Thus, a 10 second video resulted in roughly 300 frames. The frame best representing the subjects posed unstrained smile in both the views were selected. This frame was identified as “held smile”, which was one of the 15 consecutive frames in which the smile did not change[14]. The selected frames from both the views were uploaded to Smile DesignerPro software for rotation calibration and millimeter scale measurements using the width of upper central incisors as landmark for calibration of scale to correct the magnification errors[15].

Dimensional analysis were quantified for skeletal, dental and soft tissue structures in all three planes of space in frontal and profile view[16]. 2 parameters for skeletal, 5 parameters for dental and 7 parameters for soft tissue structures were selected in both the views (Table 1). The following parameters were measured using Smile DesignerPro software and Microsoft PowerPoint Office (2013 version) which comprised of Objective Evaluations done on the photograph in two views.

1. **Profile(Fig 7)**: It is the relationship between two lines; one dropped from the bridge of nose to the base of upper lip and a second one extending from that point downward to the chin.[17]
2. **Vertical thirds(Fig 8)**: The ideal face is divided vertically into equal thirds by horizontal lines adjacent to the hairline, the nasal base, and menton.[18]
3. **Anteroposterior relationship of upper incisor to forehead (Fig 9)**: Three vertical reference lines were constructed in the profile view. Line 1 through FFA point of forehead, line 2 through Glabella, and line 3 through maxillary central incisors FA point. The AP relationship of the upper central incisors to the forehead was measured as the distance between line 1 and line 3 using a metric ruler.[19]

4. **Tooth Proportions (Golden Proportion, Lombardi)**: When viewed from frontal aspect, the width of each anterior tooth is 62% width of the adjacent tooth (mathematical ratio is 1.6:1:0.6).[20]
5. **Dental Midline (Fig 13)**: The facial midline is identified using soft tissue nasion, nose base, philtrum. The facial midline should coincide with the maxillary and mandibular incisor midline or at least be minimally parallel.[21]
6. **Maxillary incisor exposure(Fig 14)**: Maximum amount on vertical display of maxillary right central incisor during smile.[22]
7. **Lower incisor exposure (Fig 15)**: Maximum amount of vertical display of lower right central incisor during smile.
8. **Nasal contour (Fig 10)**: It is classified into straight nose, convex nose in profile view. [23]
9. **Jaw profile field (Fig 12)**: Depending upon the location of subnasale point relative to the skin nasion perpendicular, there are typical profile variations: Average face – Subnasale lying on skin nasion perpendicular, anteface – subnasale lying in front of skin nasion perpendicular, retroface – subnasale lying behind skin nasion perpendicular. Based on the change of soft tissue pogonion relative to subnasale; nine different profile types can be seen.[23]
10. **Slope of Forehead (Fig 11):** The lateral forehead contour is steep, flat, protruding.[23]
11. **Smile arc (Fig 18)**: It is the curvature of maxillary incisal edges and canines relative to the curvature of lower lip while smiling.[26]
12. **Buccal Corridor**: It is calculated as the difference between the inner intercommisural width and the visible maxillary dentition width divided by the inner intercommisural width. The ratio was reported as a percentage. Six sizes of buccal corridors were created: narrow (0%), medium – narrow (5%), medium (10%), medium – broad (15%), broad (20%), extrabroad (25%). [27]

13. **Interlabial gap(Fig 17)** : Distance between the most inferior portion of the tubercle of the upper lip and deepest midline point on the superior margin of lower lip to maxillary right central incisor edge.[28]
14. **Smile line(Fig 16)** : Divided into three categories as follows ; High smile – reveals the total cervicoincisal length of the upper anterior teeth and a continuous band of gingiva, Average smile – Reveals 75-100% of the maxillary anterior teeth and the interproximal gingiva only, Low smile line – Displays less than 75% of the anterior teeth.[29]

PARAMETERS ANALYSED ON PHOTOGRAPH – TABLE 1

	SAGITTAL	TRANSVERSE	VERTICAL
SKELETAL	1.Profile		2.Vertical thirds
DENTAL	3.Anteroposterior position of maxillary incisors to forehead	4.Tooth proportions – Golden Proportion 5. Dental Midline	6. Upper Incisor exposure 7. Lower incisor exposure
SOFT TISSUE	8. Nasal contour 9. Gnathic profile field 10. Slope of Forehead	11. Smile arc 12. Buccal Corridor	13.Interlabial gap 14. Smile line

Subjective analysis for evaluation of smile esthetics individually, was carried out using a questionnaire comprising of 11 questions. Questions were framed based on etiology, diagnosis and treatment planning. A grading scale of 1 to 5 was used to assess the attractiveness or unattractiveness of various parameters. The questionnaire was distributed to 20 subjects (10 males,

10 females) together with a template consisting of their own photographs in frontal and profile view. The questionnaire is presented on the facing page.

Grading scale is as follows:

Attractive	Unattractive
1- Least attractive	1- Least unattractive
2- Little less attractive	2- Little less unattractive
3– Average	3– Average
4- Attractive	4- Unattractive
5– Most attractive	5– Most unattractive

SRI RAMAKRISHNA DENTAL COLLEGE AND HOSPITAL

DEPARTMENT OF ORTHODONTICS AND DENTOFACIAL ORTHOPEDICS

EVALUATION OF SMILE ESTHETICS USING DIMENSIONAL ANALYSIS

INSTRUCTIONS: Answer all the questions and grade your answers from 1 to 5 with 1 being least and 5 being most

PATIENT NAME:

1. What do you feel about your smile and how would you relate it to the overall facial attractiveness?
   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

2. What do you feel about the arrangement of your teeth and how would you relate it to the overall facial attractiveness?
   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

3. What do you feel about lower teeth exposure during smile and how would you relate it to overall facial attractiveness?

   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

4. What do you feel about the exposure of your gums during smile and how would you relate it to the overall facial attractiveness?

   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

5. What do you feel about size and position of lips with respect to nose and chin?

   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

6. What do you feel about the size and position of your nose and how would you relate it to overall facial attractiveness?

   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

7. What do you feel about the role of chin in overall facial attractiveness?

   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

8. How do you relate the symmetry of face on right and left side to overall facial attractiveness?

   a. Attractive | 1 2 3 4 5 |
   b. Unattractive | 1 2 3 4 5 |
   c. I don't know

9. What is your opinion regarding the vertical proportions of upper, middle and lower one third of face and how would you relate it to overall facial attractiveness?

   a. Attractive | 1 2 3 4 5 |

   b. Unattractive | 1 2 3 4 5 |

   c. I don't know

10. Which of the following structures do you wish to correct to improve overall facial attractiveness?

    a. Teeth

    b. Lips

    c. Gums

    d. Nose

    e. Chin

    f. All of the above

    g. None of the above

11. Which of the following structures do you find to be the most attractive in both the photographs?

Frontal	Profile
Teeth	Teeth
Lips	Lips
Gums	Gums
Nose	Nose
Position of lower jaw	Position of lower jaw

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CONSENT FORM

I Mr./Ms./Mrs. _____ aged _____ years was made aware by the doctor about the study that involves capturing a video to analyze my smile.

I hereby give my consent to use my records for educational purposes and for publication in articles or books. I agree to participate in this study and give my full consent for the videographic recording procedures.

Date:

Place:

Patient Signature:

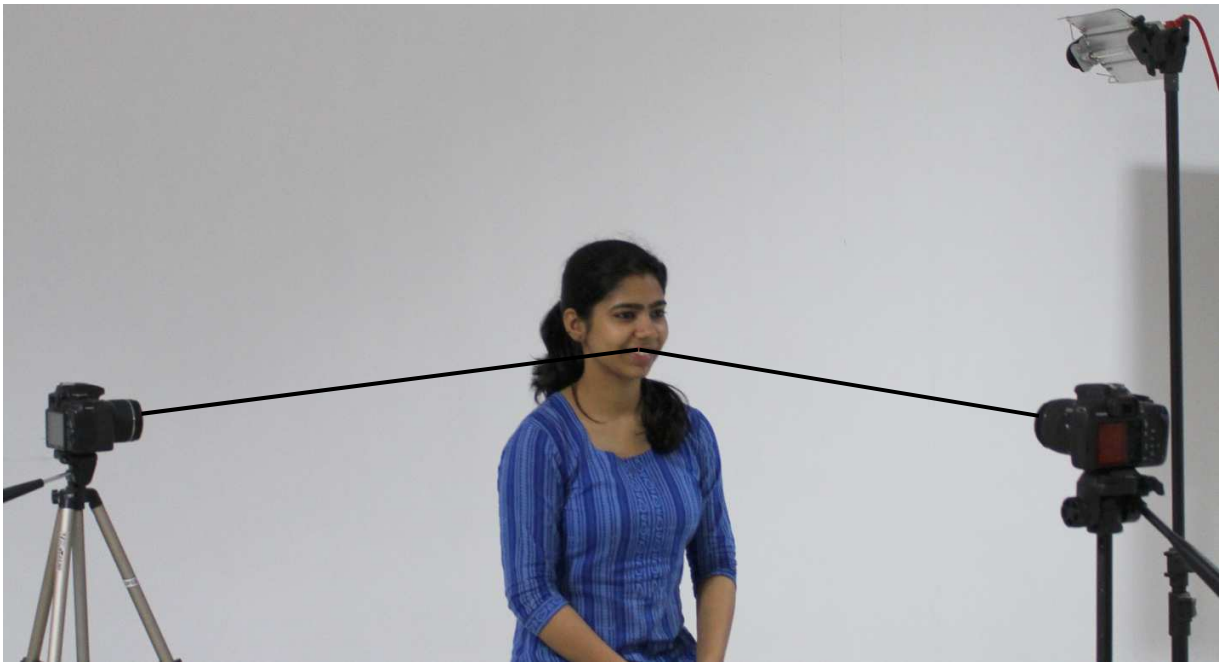


Figure 6 – Standardization of sample – Cameras placed at right angles to each other.

Figure 7 - Profile

Figure 8 – Vertical Proportions

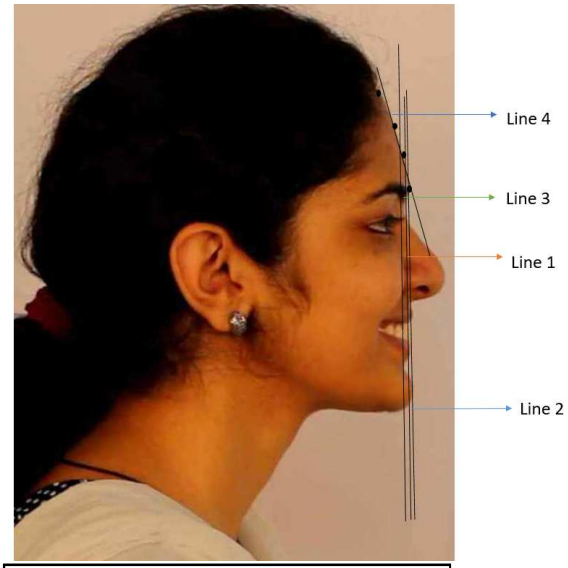


Figure 9 – AP relationship of upper incisors to forehead

Figure 10 – Nasal Contour

Figure 11 – Slope of forehead

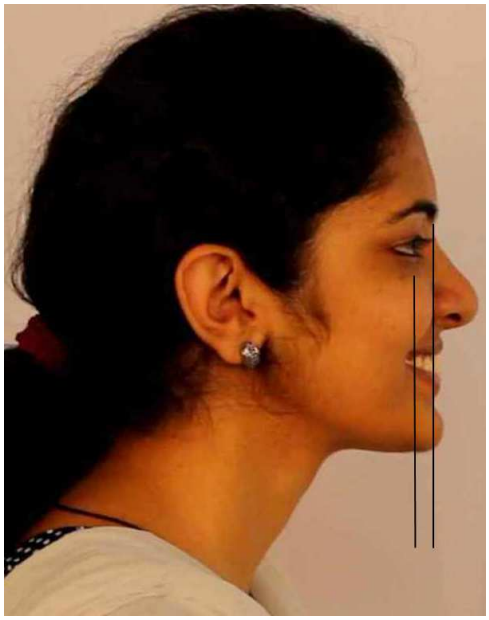


Figure 12 – Gnathic profile field

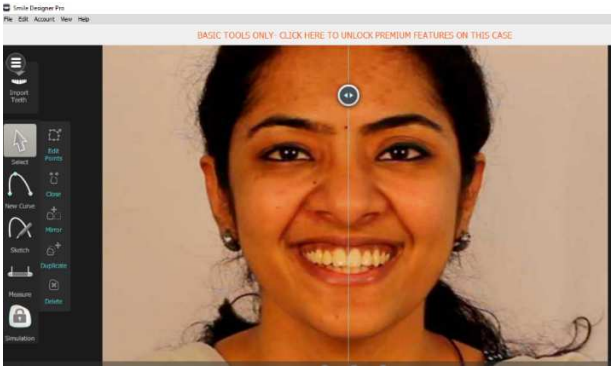


Figure 13 – Dental Midline

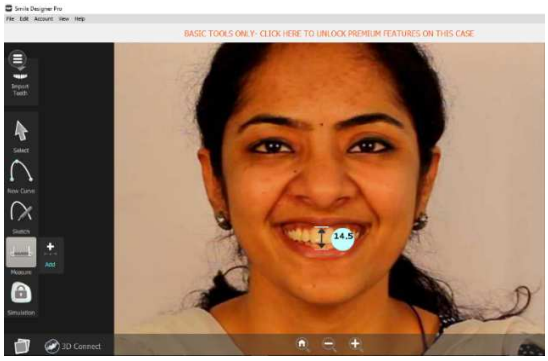


Figure 14 – Upper incisor exposure

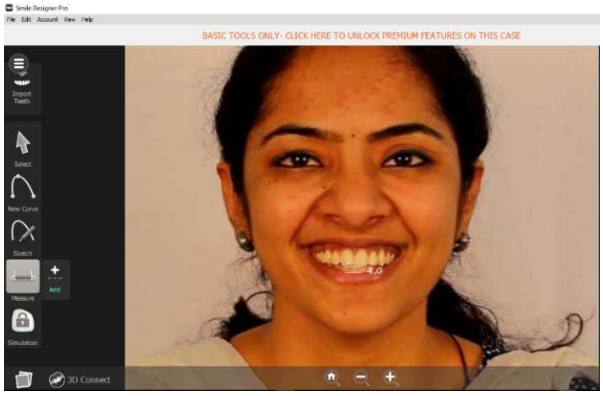


Figure 15 – Lower incisor exposure

Figure 16 – Smile line

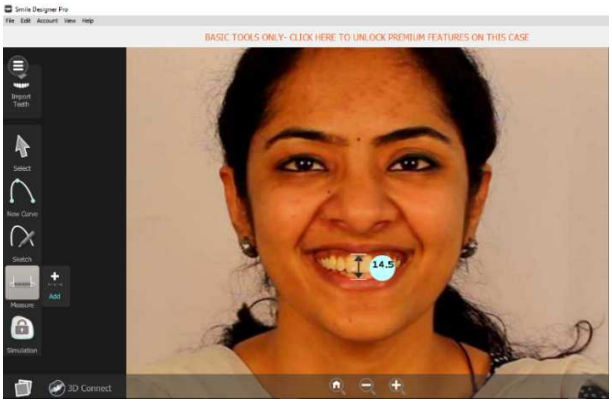


Figure 17 – Interlabial gap

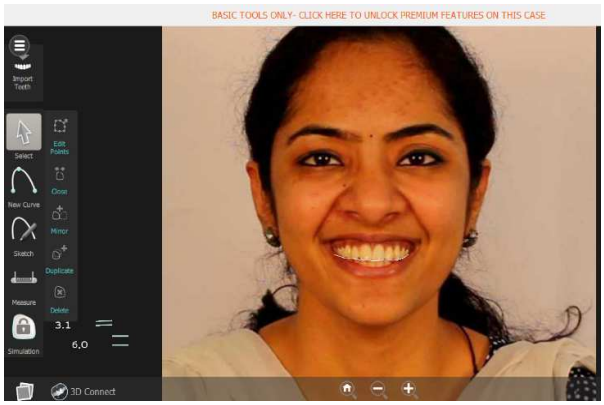


Figure 18 – Smile arc

RESULTS

RESULTS

A total of 20 samples were included in the study (10 males (Group A), 10 females (Group B)) with an age range of 18-23 years. Objective analysis was carried out on photographs in frontal and profile view. Subjective analysis was carried out by the subjects themselves using the questionnaire together with a template consisting of their own photographs in frontal and profile view for perception of their own smile and relating it to overall facial attractiveness.

STATISTICAL ANALYSIS:

Statistical analysis were done using the software SPSS version 22.0 for Windows 10. For continuous variables, means and standard deviations were calculated. Chi- square test, N – par test, ANOVA test, Percentage analysis, Cross tabulations were carried out to evaluate the statistical significance of each parameter in all three planes of space in frontal and profile view. For all tests, the significance level was set at 0.05.

PARAMETERS ASSESSED:

I. Intra group comparison of objective analysis - males
II. Intra group comparison of objective analysis – females
III. Intra group comparison of subjective analysis – males
IV. Intra group comparison of subjective analysis – females
V. Inter group comparison for objective analysis – frontal
VI. Inter group comparison for objective analysis – profile
VII. Inter group comparison for subjective analysis – frontal
VIII. Inter group comparison for subjective analysis – profile

IX. Intergroup comparison for evaluating order of preference of facial structures from frontal and profile view - males

X. Intergroup comparison for evaluating order of preference of facial structures from frontal and profile view - females

XI. Intergroup comparison for correction of various structures between males and females

I. INTRAGROUP COMPARISON OF MALES (OBJECTIVE):

A. Frontal

1. Transverse Plane

i. Dental

a. Midline - In group A, since P value > 0.05 there is no significant difference between midlines deviated to right, left or midlines that are coincident showing that 60% of samples had a coincident midline and 20% had their midlines deviated to right and left respectively.(Table -2,3; Graph-1)

b. Golden Proportion - It is disproportionate for all the samples, and hence a constant.

ii. Soft tissue

a. Smile Arc - In group A, since P value > 0.05, there is no significant difference between the consonant and non-consonant smile arc showing that 70% of samples had a consonant smile arc, 30% had a non-consonant smile arc.(Table-3,4; Graph 2)

b. Buccal Corridor - In group A, since P value is >0.05, there is no significant difference between the categories of buccal corridor. 50% of males had broad, 30% had medium broad, 10 % each had medium and narrow buccal corridor. (Table - 3, 5; Graph 3)

II. Vertical Plane:

a. Skeletal

i. Vertical Thirds were disproportionate for all the samples and hence kept a constant.

b. Dental

i. Upper Incisor Exposure - In group A, mean (+/- SD) of upper incisor exposure is 10.14+/- 1.571mm. (Table 6, Graph 4).

ii. Lower Incisor Exposure - In group A, mean (+/-SD) of lower incisor exposure is 3.34+/- 2.001. (Table 7, Graph 5)

c. Soft tissue

i. Smile line - Among group A, since P value > 0.05, there is no significant difference between low, average and high smile lines with 60% of samples having a low smile line, 30% having average and 10% having a high smile line.(Table - 3,8; Graph 6).

ii. Interlabial gap - In group A, mean(+/-SD) of interlabial gap is 13.37+/-2.462mm.(Table 9, Graph 7)

B. Profile View

I. Sagittal

a. Skeletal

i. Profile - Among Group A, convex profile is constant over all the samples.

b. Dental

i. Labiolingual inclination of upper incisors to forehead - In group A, the mean (+/-SD) labiolingual inclination was -0.25mm+/- 3.75mm showing that males had maxillary incisors positioned posterior to foreheads FFA point.(Table 10, Graph 8)

c. Soft tissue

i. Gnathic Profile Field - Among group A, since P value > 0.05, there is no significant difference between those with average face, gnathic profile, slanting backward and anteface, gnathic profile, slanting backward showing that 50% of the samples had average and anteface chin respectively. (Table - 3, 11, Graph 9)

ii. Nasal Contour - Among group A, straight nasal contour is constant over all the samples.

iii. Slope of forehead - Among group A, since P value <0.05 there is a significant difference between flat, steep and protruding forehead showing that samples with steep forehead being 80% more prevalent than those with flat(10%) and protruding(10%) slopes of forehead. (Table-3, 12; Graph 10).

II. INTRAGROUP COMPARISON OF FEMALES (OBJECTIVE):

A. Frontal

1. Transverse Plane

i. Dental

a. Midline - In group B, since P value <0.05, females who had their midline shifted to right (90%) was more than others who had a coincident midline (10%). (Table-13,14;Graph 11)

b. Golden Proportion - It is disproportionate for all the samples and hence a constant.

ii. Soft tissue

a. Smile arc - In group B, since P value > 0.05, there is no significant difference between consonant and non-consonant smile arc showing that females with consonant smile arc is 70% and non-consonant smile arc is 30%. (Table 14, 15; Graph 12)

b. Buccal corridor - In group B, since P value is >0.05, there is no significant difference between the categories of buccal corridor showing that females had medium and medium broad categories of buccal corridor of 40%, narrow(10%) and broad (10%). (Table-14, 16; Graph 13)

2. Vertical Plane

i. Skeletal

a. Vertical thirds – Vertical thirds proportions of the face were disproportionate for all and kept constant.

ii. Dental

a. Upper Incisor Exposure - In group B, mean (+/-SD) of upper incisor exposure is 11.4+/-2.06mm. (Table 6, Graph 14)

b. Lower incisor exposure - In group B, mean (+/-SD) of lower incisor exposure is 1.73+/-2.161. (Table 7, Graph 15)

iii. Soft tissue

a. Smile line - Among group B, since P value > 0.05, there is no significant difference between low, average and high smile lines with average smile line being 80% more prevalent followed by high smile line (20%). (Table-14, 17; Graph 16)

ii. Interlabial gap - In group B, mean of interlabial gap is 13.63+/-2.833. (Table 9, Graph 17)

B. Profile

1. Sagittal Plane

i. Skeletal

a. Profile - Among group B, since P value > 0.05, there is no significant difference between straight and convex profiles showing that 80% of the samples had a convex profile and 20% had a straight profile. (Table-14, 18; Graph 18)

ii. Dental

a. Labiolingual inclination of upper incisors to forehead - In group B, mean on upper incisor inclination to forehead is -2.3 +/- 1.251mm showing that showing that females had maxillary incisors positioned posterior to foreheads FFA point. (Table-10, 14; Graph 19)

iii. Soft tissue

a. Gnathic profile field - In group B, since P value < 0.05, there is a significant difference between average face, gnathic profile, slanting backward and average face, gnathic profile, slanting backward showing that among females those with average face, gnathic profile, slanting backward(90%) more prevalent. (Table-14, 19;Graph 20)

b. Nasal Contour - Among group B, since P value < 0.05, there is a significant difference between those with straight and convex nose; with straight nose being 90% more prevalent. (Table-14, 20; Graph 21)

c. Slope of forehead - Among group B, since P value <0.05 there is a significant difference between flat, steep and protruding forehead indicating that samples in this group had flat forehead 90% more prevalent. (Table 14, 21; Graph 22)

III. INTRA GROUP COMPARISON OF MALES FOR SUBJECTIVE ANALYSIS (Tables-22, 23)

A. Frontal –

(1) Transverse Plane

a. Skeletal – Symmetry of face - In group A, 40% of samples said their face symmetry were very unattractive, 30% said it was average, 20% said it was unattractive, 10% said it was very attractive.(Graph 23)

b. Dental – Arrangement of teeth - In group A, 70% of samples said their teeth arrangement was unattractive, 10% each said their teeth arrangement was attractive, average and very unattractive.(Graph 24)

c. Soft tissue – Smile Attractiveness - In group A, 50% of samples rated their smile as unattractive, 30% of samples rated their smile as very unattractive and 20% rated their smile as average. (Graph 25)

(2) Vertical Plane

a. Skeletal – Vertical Proportions of face - In group A, 60% of samples said vertical proportions of face their face was average, 30% said it was unattractive, 10% said it was very unattractive. (Graph 26)

b. Dental – Lower incisor exposure - In group A and B, 40% of samples said their lower teeth exposure was average, 30% of samples said their lower teeth exposure was very attractive and rest 20% and 10% said their lower teeth exposure was attractive and very unattractive.(Graph 27)

c. Soft tissue – Exposure of Gums - In group A, 40% of subjects had rated their gingival exposure as average, 30% as unattractive and 10% as attractive, unattractive and average respectively. (Graph 28)

B. Profile

(1) Sagittal – Soft tissue

a. Relationship of position of Lips to nose and chin position - Group A, evaluated the size and position of lips with respect to nose and chin as unattractive (40%), average (40%), 10% attractive and 10% very attractive. (Graph 29)

b. Size and position of Nose - In group A, 40% of subjects had rated the relationship of size and position of nose to overall facial attractiveness as unattractive, 20% as very attractive, attractive and 10% as average and very unattractive respectively. (Graph 30)

c. Chin - In group A, 60% of subjects had rated the role of chin in overall facial attractiveness as average, 20% as unattractive and very unattractive respectively. (Graph 31)

IV. INTRA GROUP COMPARISON OF FEMALES FOR SUBJECTIVE ANALYSIS (Table 24, Table 25)

A. Frontal –

(1)Transverse Plane

a. Skeletal – Symmetry of face - In group B, 50% of samples said their face symmetry was average, 30% said it was unattractive, 10% each said it was average and very unattractive respectively. (Graph 23)

b. Dental – Arrangement of teeth - In group B, 40% of samples said their teeth arrangement was average, 30% said it was unattractive, 20% said it was very unattractive and 10% said it is attractive. (Graph 24)

c. Soft tissue – Smile Attractiveness - In group B, 40% of samples rated their smile as unattractive, 30% of samples rated their smile as average, 20% of samples rated their smile as attractive and 10% of samples rated their smile as very unattractive. (Graph 25)

(2) Vertical Plane

a. Skeletal – Vertical Proportions of face - In group B, 30% of samples said vertical proportions of face their face was attractive, unattractive and average respectively and 10% said it was very attractive. (Graph 26)

b. Dental – Lower incisor exposure - In group B, 40% of samples said their lower teeth exposure was average. 20% of samples said their lower teeth exposure was attractive, average and unattractive respectively. (Graph 27)

c. Soft tissue – Exposure of Gums - In group B, 40% of subjects had rated their gingival exposure as attractive, 30% as unattractive, 20% as average and 10% as attractive. (Graph 28)

B. Profile -

(1) Sagittal – Soft tissue

a. Relationship of position of Lips to nose, chin position - In Group B, the size and position of lips with respect to nose and chin was unattractive (40%), average (40%), attractive (20%) respectively. (Graph 29)

b. Size and position of Nose - In group B, 80% of subjects had rated the relationship of size and position of nose to overall facial attractiveness as average, 10% rated it as attractive and unattractive respectively. (Graph 30)

c. Chin - In group B, 50% of subjects had rated the role of chin to overall facial attractiveness as average, 20% as average and unattractive; respectively and 10% as very attractive. (Graph 31)

V. INTER GROUP COMPARISON FOR OBJECTIVE ANALYSIS – FRONTAL

I. Dental Parameters – Transverse Plane

A. Midline - Since P value < 0.05 (5% level), there is a significant difference between the Coincident, Left and Right Percentages of Midline. Therefore the samples whose Midline is deviated to Right is more in percentage (55%) than those whose midlines are coincident (35%), deviated to left (10%). (Tables - 26, 27; Graph 32)

B. Golden proportion of teeth is disproportionate for all the samples and is a constant

II. Soft tissue - Transverse Plane

a. Smile arc - Since P value > 0.05 (5% level), there is no significant difference between the Consonant and non-consonant of smile arc showing that 70% of samples had a consonant smile arc and 30% of sample had a non-consonant smile arc. (Table 28; Graph 33)

b. Buccal Corridor - Since P value > 0.05 (5% level), there is no significant difference among the samples showing that the sample had medium broad BC of 35%, broad BC of 30%, medium BC of 25%, narrow BC of 10%. (Table 29; Graph 34)

III. Vertical Plane

1. Skeletal

a. Vertical thirds were disproportionate and hence constant for all samples.

2. Dental

a. Upper Incisor exposure - Since P value is greater than 0.05 (5% level), there is no significant difference between Group A and B in the average score on this parameter. Group B had greater upper incisor exposure than group A. (Tables - 30,31; Graph 35)

b. Lower Incisor exposure - Since P value is greater than 0.05 (5% level), there is no significant difference between Group A and B in the average score on this parameter. Group A had greater lower incisor exposure than Group B. (Tables - 30,32; Graph 36)

3. Soft tissue

a. Smile Line - Since P value > 0.05 (5% level), there is a no significant difference between the low, average and high smile line. 55% of samples had an average smile line, followed by low smile line of 30% and High smile line of 15%. (Table 33; Graph 37)

b. Interlabial gap - Since P value > 0.05 (5% level), there is no significant difference between male and female in the average score on this parameter. Group A, had a mean interlabial gap of 13.37+/-2.462mm and Group B had a mean value of 13.63 +/-2.833mm. Group B had more interlabial gap than group A. (Tables - 9,34; Graph 38)

VI. INTER GROUP COMPARISON FOR OBJECTIVE ANALYSIS – PROFILE

I .SAGITTAL

1. Skeletal

a. Profile - Since P value < 0.05 (5% level), there is a significant difference between samples with straight profile and convex profile. Therefore the samples whose profile is convex was very high (90%) than those with straight profile. (Table 33, Graph 39)

2. Dental

a. Labiolingual inclination - Mean of upper incisor inclination to forehead is -0.25mm in group A and -2.3mm in group B. Since P value > 0.05 (5% level), there is no significant difference between male and female in the average score on this parameter. (Tables - 34,35; Graph 40)

3. Soft tissue

a. Gnathic Profile Field - Since P value > 0.05 (5% level), there is no significant difference between average face, gnathic profile, backward slanting and anteface, gnathic profile, backward slanting. 70% of the sample had average face, gnathic profile, 30% of the sample had anteface, gnathic profile, backward slanting. (Table 36, Graph-9,20)

b. Nasal Contour - Since P value < 0.05 (5% level), there is a significant difference between the straight and convex of nasal contour. Therefore, the samples with straight nose more in percentage (95%) than other sample. (Table 37, Graph 42)

c. Slope of forehead - Among group A, since P value <0.05 there is a significant difference between flat, steep and protruding forehead, with steep forehead being 80% more prevalent. Among group B, since P value <0.05 there is a significant difference between flat, steep and protruding forehead, with flat forehead being 90% more prevalent. (Table 38, Graph 43)

VII. INTER GROUP COMPARISON FOR SUBJECTIVE ANALYSIS – FRONTAL (Tables - 39, 42)

A. Frontal – (1) Transverse Plane

a. Skeletal – Symmetry of face - In group A, 40% of samples said their face symmetry were very unattractive, 30% said it was average, 20% said it was unattractive, 10% said it was very attractive. In group B, 50% of samples said their face symmetry was average, 30% said it was unattractive, 10% each said it was average and very unattractive respectively. (Graph 23)

b. Dental – Arrangement of teeth - In group A, 70% of samples said their teeth arrangement was unattractive, 10% each said their teeth arrangement was attractive, average and very

unattractive. In group B, 40% of samples said their teeth arrangement was average, 30% said unattractive, 20% very unattractive and 10% said it is average.(Graph 24)

c. Soft tissue – Smile Attractiveness - In group A, 50% of samples rated their smile as unattractive, 30% of samples rated their smile as very unattractive and 20% rated their smile as average. In group B, 40% of samples rated their smile as unattractive, 30% of samples rated their smile as average, 20% of samples rated their smile as attractive and 10% of samples rated their smile as very unattractive. (Graph 25)

(2) Vertical Plane

a. Skeletal – Vertical Proportions of face

In group A, 60% of samples said vertical proportions of face their face was average, 30% said it was unattractive, 10% said it was very unattractive. In group B, 30% of samples said vertical proportions of face their face was attractive, unattractive and average respectively and 10% said it was very attractive. (Graph 26)

b. Dental – Lower incisor exposure - In group A and B, 40% of samples said their lower teeth exposure was average. In group A, 30% of samples said their lower teeth exposure was very attractive and rest 20% and 10% said their lower teeth exposure was attractive and very unattractive. In group B, 20% of samples said their lower teeth exposure was attractive, average and unattractive respectively. (Graph 27)

c. Soft tissue – Exposure of gums - In group A, 40% of subjects had rated their gingival exposure as average, 30% as unattractive and 10% as attractive, unattractive and average respectively. In group B, 40% of subjects had rated their gingival exposure as attractive, 30% as unattractive, 20% as average and 10% as attractive. (Graph 28)

VIII. INTER GROUP COMPARISON FOR SUBJECTIVE ANALYSIS – PROFILE (Tables – 40,41)

A. Profile – (1) Sagittal – Soft tissue

a. Relationship of position of Lips to nose, chin position. - Both group A and group B, evaluated the size and position of lips with respect to nose and chin as unattractive (40%) and average (40%) respectively. (Graph 29)

b. Size and position of Nose. - In group A, 40% of subjects had rated the relationship of size and position of nose to overall facial attractiveness as unattractive, 20% as very attractive, attractive and 10% as average and very unattractive respectively. In group B, 80% of subjects had rated the relationship of size and position of nose to overall facial attractiveness as average, 10% rated it as attractive and unattractive respectively. (Graph 30)

c. Chin - In group A, 60% of subjects had rated the role of chin in overall facial attractiveness as average, 20% as unattractive and very unattractive respectively. In group B, 50% of subjects had rated the role of chin to overall facial attractiveness as average, 20% as average and unattractive; respectively and 10% as very attractive. (Graph 31)

IX. INTERGROUP COMPARISON FOR EVALUATING ORDER OF PREFERENCE OF FACIAL STRUCTURES FROM FRONTAL AND PROFILE VIEW – MALES (Table 43)

A. Frontal - From the frontal view, males had selected teeth as the best viewable structure (90%); after teeth; lips (70%), gums (60%), nose (50%) was the order of preference of structures from the frontal view. (Graph 44)

B. Profile - From the profile view, 70% of males had chosen position of lower jaw as the best viewable parameter; after position of lower jaw, nose (40%) and teeth (10%) were the order preference in the profile view. (Graph 44)

X. INTERGROUP COMPARISON FOR EVALUATING ORDER OF PREFERENCE OF FACIAL STRUCTURES FROM FRONTAL AND PROFILE VIEW – FEMALES (Table 43)

A. FRONTAL - Females had chosen teeth as the best viewable structure (90%); after teeth; Gums (80%), Nose (70%), Lips (60%), Position of lower jaw (40%) was the order of preference of structures from the frontal view. (Graph 44)

B. PROFILE – Among females; 40% had chosen position of lower jaw as the best viewable structure from the profile view followed by nose (20%).

XI. INTERGROUP COMPARISON FOR CORRECTION OF VARIOUS STRUCTURES BETWEEN MALES AND FEMALES (Table 44, Graph 45)

Out of 20 samples, 16 of them wanted correction in any part of the face, to increase the facial attractiveness. Among these, 9 belonged to group A (males) and 7 belonged to group B(females).

Among males, 77.8% opted for correction of their teeth, 55.6 % opted for correction of chin and nose each, 44.4% opted for correction of lips and 22.2% opted for correction of gums in the order of preference. Among females, 71.4% opted for correction of their teeth, 28.6% opted for correction of chin and 14.3% each opted for correction of lips, gums and nose in the order of preference.

Table 2 – Midline (Males)

	Midline-Males	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Coincident	6	60.0	60.0	60.0
	Left	2	20.0	20.0	80.0
	Right	2	20.0	20.0	100.0
	Total	10	100.0	100.0	

Table 3 – P values (Males)

Males	Chi - square	df	P value
Midline	3.200	2	0.202
Smile arc	1.600	1	0.206
Buccal Corridor	4.400	3	0.221
Smile line	3.800	2	0.150
Gnathic Profile field	0.000	1	1.000
Slope of forehead	9.800	2	0.007

Table 4 – Smile arc (Males)

	Smile arc-Males	Frequency	%	Valid %	Cumulative %
Valid	consonant	7	70.0	70.0	70.0
	non consonant	3	30.0	30.0	100.0
	Total	10	100.0	100.0	

Table 5 – Buccal Corridor (Males)

	Buccal Corridor-Males	Frequency	%	Valid %	Cumulative %
Valid	Narrow	1	10.0	10.0	10.0
	Medium	1	10.0	10.0	20.0
	Medium broad	3	30.0	30.0	50.0
	Broad	5	50.0	50.0	100.0
	Total	10	100.0	100.0	

Table 6 – Upper incisor exposure (Males)

	Mean			Std. Deviation		
	Male	Female	Total	Male	Female	Total
Upper incisor exposure	10.1400	11.4000	10.7700	1.57141	2.06344	1.89850

Table 7 – Lower incisor exposure (Males)

	Mean			Std. Deviation		
	Male	Female	Total	Male	Female	Total
Lower incisor exposure	3.3400	1.7300	2.5350	2.00122	2.16182	2.18927

Table 8 – Smile line (Males)

Smile line		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	6	60.0	60.0	60.0
	Average	3	30.0	30.0	90.0
	High	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

Table 9 – Interlabial gap (Males)

	Mean			Std. Deviation		
	Male	Female	Total	Male	Female	Total
Interlabial gap	13.3700	13.6300	13.5000	2.46218	2.83355	2.58701

Table 10 – Labiolingual inclination (Males)

	Mean			Std. Deviation		
	Male	Female	Total	Male	Female	Total
Labiolingual inclination	-.2500	-2.3000	-1.2750	3.75093	1.25167	2.91762

Table 11 – Gnathic Profile Field (Males)

Gender		Gnathic Profile Field	Frequency	Percent	Valid Percent	Cumulative Percent
Male	Valid	Average face, gnathic profile, slanting backward	5	50.0	50.0	50.0
		Anteface, gnathic profile, slanting backward	5	50.0	50.0	100.0
		Total	10	100.0	100.0	

Table 12 – Slope of forehead (Males)

	Slope of forehead - Males	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Flat	1	10.0	10.0	10.0
	Steep	8	80.0	80.0	90.0
	Protruding	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

Table 13 – Midline (Females)

	Midline - Females	Frequency	%	Valid %	Cumulative %
Valid	Coincident	1	10.0	10.0	10.0
	Right	9	90.0	90.0	100.0
	Total	10	100.0	100.0	

Table 14 – P values (Females)

Females	Chi-square	df	P value
Midline	6.400	1	0.011
Smile arc	1.600	1	0.206
Buccal Corridor	3.600	3	0.308
Smile line	3.600	1	0.058
Profile	3.600	1	0.058
Ganthic profile field	0.400	1	0.011
Nasal Contour	6.400	1	0.011
Slope of forehead	6.400	1	0.011

Table 15 – Smile arc (Females)

	Smile arc - Females	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	consonant	7	70.0	70.0	70.0
	non consonant	3	30.0	30.0	100.0
	Total	10	100.0	100.0	

Table 16 – Buccal Corridor (Females)

	Buccal corridor - Females	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Narrow	1	10.0	10.0	10.0
	Medium	4	40.0	40.0	50.0
	Medium broad	4	40.0	40.0	90.0
	Broad	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

Table 17 – Smile line (Females)

	Smile line - Females	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Average	8	80.0	80.0	80.0
	High	2	20.0	20.0	100.0
	Total	10	100.0	100.0	

Table 18 – Profile (Females)

	Profile - Females	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Straight	2	20.0	20.0	20.0
	Convex	8	80.0	80.0	100.0
	Total	10	100.0	100.0	

Table 19 – Gnathic Profile Field (Females)

Gnathic Profile field - Females		Frequency	%	Valid %	Cumulative %
Valid	anteface, gnathic profile, slanting backwards	9	90.0	90.0	90.0
	average face, gnathic profile, slanting backward	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

Table 20 – Nasal Contour (Females)

	Nasal Contour - Females	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Straight	9	90.0	90.0	90.0
	Convex	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

Table 21 – Slope of forehead (Females)

	Slope of forehead - Females	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Flat	9	90.0	90.0	90.0
	Steep	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

Table 22 – Subjective assessments - Males

PARAMETERS	GENDER	Very unattractive	Unattractive	Average	Attractive	Very attractive	Very unattractive	Unattractive	Average	Attractive	Very attractive
Smile attractiveness	Male	3	5	2	0	0	30%	50%	20%	0%	0%
Teeth arrangement	Male	1	7	1	0	1	10%	70%	10%	0%	10%
Lower teeth exposure	Male	1	0	4	2	3	10%	0%	40%	20%	30%
Gums exposure	Male	1	3	4	1	1	10%	30%	40%	10%	10%
Lip to nose,chin position	Male	0	4	4	1	1	0%	40%	40%	10%	10%
Nose size and position	Male	1	4	1	2	2	10%	40%	10%	20%	20%
Chin	Male	2	2	6	0	0	20%	20%	60%	0%	0%
Face symmetry	Male	4	2	3	0	1	40%	20%	30%	0%	10%
Vertical proportion	Male	1	3	6	0	0	10%	30%	60%	0%	0%

Table 23 – P value – Subjective assessment - Males

	Chi-Square	df	P value
Smile attractiveness	1.4	2	0.497
Teeth arrangement attractiveness	10.8	3	**0.013***
Lower teeth exposure attractiveness	2	3	0.572
Gums exposure attractiveness	4	4	0.406
Lip to nose, chin position attractiveness	3.6	3	0.308
Nose size and position attractiveness	3	4	0.558
Chin attractiveness	3.2	2	0.202
Face symmetry attractiveness	2	3	0.572
Vertical proportion attractiveness	3.8	2	0.15

* P value significant at 5% level.

Table 24 – Subjective assessments - Females

PARAMETERS	GENDER	Very unattractive	Unattractive	Average	Attractive	Very attractive	Very unattractive	Unattractive	Average	Attractive	Very attractive
Smile attractiveness	Female	1	4	3	2	0	10%	40%	30%	20%	0%
Teeth arrangement	Female	0	3	4	1	2	0%	30%	40%	10%	20%
Lower teeth exposure	Female	0	2	4	2	2	0%	20%	40%	20%	20%
Gums exposure	Female	0	3	2	4	1	0%	30%	20%	40%	10%
Lip to nose,chin position	Female	0	4	4	2	0	0%	40%	40%	20%	0%
Nose size and position	Female	0	1	8	1	0	0%	10%	80%	10%	0%
Chin	Female	0	2	5	2	1	0%	20%	50%	20%	10%
Face symmetry	Female	1	3	5	1	0	10%	30%	50%	10%	0%
Vertical proportion	Female	0	3	3	3	1	0%	30%	30%	30%	10%

Table 25 – P values for subjective assessments - Females

	Chi-Square	df	P value
Smile attractiveness	2.000	3	.572
Teeth arrangement attractiveness	2.000	3	.572
Lower teeth exposure attractiveness	1.200	3	.753
Gums exposure attractiveness	2.000	3	.572
Lip to nose,chin position attractiveness	.800	2	.670
Nose size and position attractiveness	9.800	2	**.007**
Chin attractiveness	3.600	3	.308
Face symmetry attractiveness	4.400	3	.221
Vertical proportion attractiveness	1.200	3	.753

Table 26 – Midline - Combined

	Midline	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Coincident	7	35.0	35.0	35.0
	Left	2	10.0	10.0	45.0
	Right	11	55.0	55.0	100.0
	Total	20	100.0	100.0	

Table 27 – P values for objective assessments - Combined

	Chi - square	df	P value
Midline	6.100	2	0.047
Smile arc	3.200	1	0.074
Buccal Corridor	2.800	3	0.423
Smile line	4.900	2	0.086
Profile	12.800	1	0.000
Gnathic profile field	3.200	1	0.074
Nasal Contour	16.200	1	0.000
Slope of forehead	7.3	2	0.026

Table 28 – Smile arc - Combined

	Smile arc	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	consonant	14	70.0	70.0	70.0
	non consonant	6	30.0	30.0	100.0
	Total	20	100.0	100.0	

Table 29 – Buccal Corridor - Combined

	Buccal Corridor	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Narrow	2	10.0	10.0	10.0
	Medium	5	25.0	25.0	35.0
	Medium broad	7	35.0	35.0	70.0
	Broad	6	30.0	30.0	100.0
	Total	20	100.0	100.0	

Table 30 - Mean Values and Std. Deviations for UI and LI exposure

	Mean			Std. Deviation		
	Male	Female	Total	Male	Female	Total
Upper incisor exposure	10.1400	11.4000	10.7700	1.57141	2.06344	1.89850
Lower incisor exposure	3.3400	1.7300	2.5350	2.00122	2.16182	2.18927

Table 31 – Numerical parameters – P values

	P value
Upper Incisor Exposure	0.142
Lower Incisor Exposure	0.101
Interlabial gap	0.829

Table – 32 – Smile line (Combined)

Smile line		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	6	30.0	30.0	30.0
	Average	11	55.0	55.0	85.0
	High	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

Table – 33 – Profile (Combined)

	Profile	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Straight	2	10.0	10.0	10.0
	Convex	18	90.0	90.0	100.0
	Total	20	100.0	100.0	

Table 34 – Labiolingual inclination (Mean, SD)

	Male	Female	Total
N	10	10	20
Mean	-.2500	-2.3000	-1.2750
Std. Deviation	3.75093	1.25167	2.91762
Minimum	-5.00	-4.00	-5.00
Maximum	7.00	-1.00	7.00

Table 35 – Labiolingual inclination (P value)

	Sum of Squares	df	Mean Square	F	P value
Between Groups	21.012	1	21.012	2.688	.118
Within Groups	140.725	18	7.818		
Total	161.737	19			

Table 36 – Gnathic Profile field (Combined)

	Gnathic profile field	Frequency	Percent	Valid %	Cumulative %
Valid	Average face, gnathic profile, slanting backward	14	70.0	70.0	70.0
	Anteface, gnathic profile, slanting backward	6	30.0	30.0	100.0
	Total	20	100.0	100.0	

Table 37 – Nasal Contour (Combined)

	Nasal Contour	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Straight	19	95.0	95.0	95.0
	Convex	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Table 38 – Slope of forehead (Combined)

	Slope of forehead	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Flat	10	50.0	50.0	50.0
	Steep	9	45.0	45.0	95.0
	Protruding	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Table 39 – Subjective Parameters (Combined)

PARAMETERS	GENDER	Very unattractive	Unattractive	Average	Attractive	Very attractive	Very unattractive	Unattractive	Average	Attractive	Very attractive
Smile attractiveness	Male	3	5	2	0	0	30%	50%	20%	0%	0%
	Female	1	4	3	2	0	10%	40%	30%	20%	0%
	Combined	4	9	5	2	0	20%	45%	25%	10%	0%
Teeth arrangement attractiveness	Male	1	7	1	0	1	10%	70%	10%	0%	10%
	Female	0	3	4	1	2	0%	30%	40%	10%	20%
	Combined	1	10	5	1	3	5%	50%	25%	5%	15%
Lower teeth exposure attractiveness	Male	1	0	4	2	3	10%	0%	40%	20%	30%
	Female	0	2	4	2	2	0%	20%	40%	20%	20%
	Combined	1	2	8	4	5	5%	10%	40%	20%	25%
Gums exposure attractiveness	Male	1	3	4	1	1	10%	30%	40%	10%	10%
	Female	0	3	2	4	1	0%	30%	20%	40%	10%
	Combined	1	6	6	5	2	5%	30%	30%	25%	10%
Face symmetry attractiveness	Male	4	2	3	0	1	40%	20%	30%	0%	10%
	Female	1	3	5	1	0	10%	30%	50%	10%	0%
	Combined	5	5	8	1	1	25%	25%	40%	5%	5%

Vertical proportion attractiveness	Male	1	3	6	0	0	10%	30%	60 %	0%	0%
	Female	0	3	3	3	1	0%	30%	30 %	30 %	10%
	Combined	1	6	9	3	1	5%	30%	45 %	15 %	5%

Table 40 – P values

	Sum of Squares	df	Mean Square	F	P value
Lip to nose, chin position attractiveness	.050	1	.050	.062	.806
Nose size and position attractiveness	.000	1	.000	.000	1.000
Chin attractiveness	3.200	1	3.200	4.114	.058

Table 41 – P values

	Sum of Squares	df	Mean Square	F	P value
Smile attractiveness	2.450	1	2.450	3.316	.085
Teeth arrangement attractiveness	4.050	1	4.050	3.359	.083
Lower teeth exposure attractiveness	.200	1	.200	.145	.708
Gums exposure attractiveness	1.250	1	1.250	1.037	.322
Face symmetry attractiveness	.800	1	.800	.655	.429
Vertical proportion attractiveness	2.450	1	2.450	3.128	.094

Table 42 – Profile view – Subjective assessments

PARAMETERS	GENDER	Very unattractive	Unattractive	Average	Attractive	Very attractive	Very unattractive	Unattractive	Average	Attractive	Very attractive
Lip to nose, chin position attractiveness	Male	0	4	4	1	1	0%	40%	40%	10%	10%
	Female	0	4	4	2	0	0%	40%	40%	20%	0%
	Combined	0	8	8	3	1	0%	40%	40%	15%	5%
Nose size and position attractiveness	Male	1	4	1	2	2	10%	40%	10%	20%	20%
	Female	0	1	8	1	0	0%	10%	80%	10%	0%
	Combined	1	5	9	3	2	5%	25%	45%	15%	10%
Chin attractiveness	Male	2	2	6	0	0	20%	20%	60%	0%	0%
	Female	0	2	5	2	1	0%	20%	50%	20%	10%
	Combined	2	4	11	2	1	10%	20%	55%	10%	5%

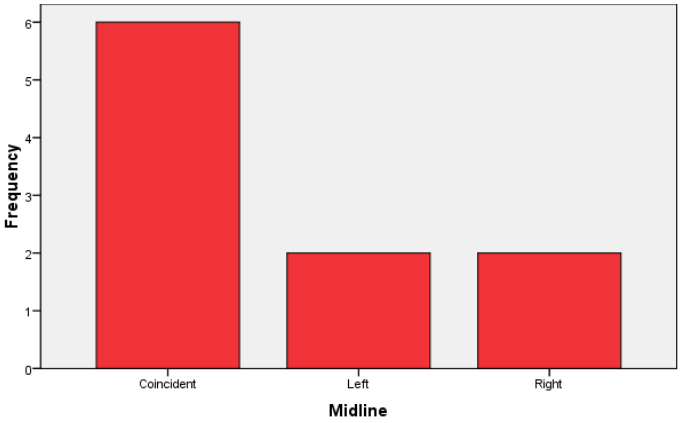
Table 43 – Order of preference of structures

	FRONTAL			% within Gender*			PROFILE			% within Gender*		
	Gender			Gender			Gender			Gender		
	Male	Female	combined	Male	Female	combined	Male	Female	combined	Male	Female	combined
TEETH	9	9	18	90.0%	90.0%	90%	1	0	1	10.0%	.0%	5%
GUM	6	8	14	60.0%	80.0%	70%	0	0	0	0	0	0%
LIP	7	6	13	70.0%	60.0%	65%	0	0	0	0	0	0%
NOSE	5	7	12	50.0%	70.0%	60%	4	2	6	40.0%	20.0%	30%
JAW POSITION	0	4	4	.0%	40.0%	20%	7	4	11	70.0%	40.0%	55%

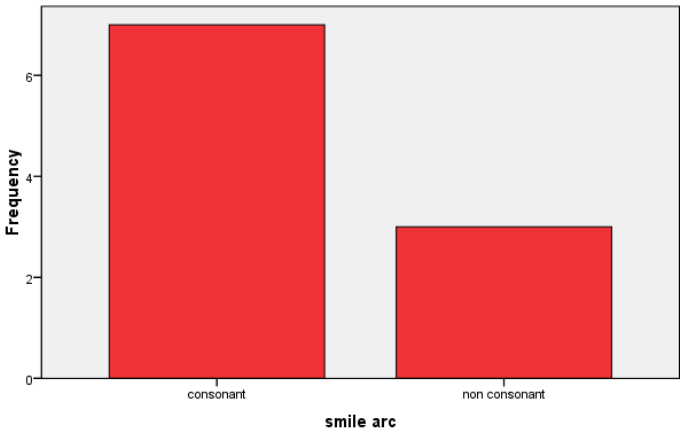
Table 44 – Correction needed (Combined)

			Correction needed					
			Teeth correction	Lip correction	Gum correction	Nose correction	Chin correction	Total
gender	Male	Count	7	4	2	5	5	9
		% within gender*	77.8%	44.4%	22.2%	55.6%	55.6%	
	Female	Count	5	1	1	1	2	7
		% within gender*	71.4%	14.3%	14.3%	14.3%	28.6%	
Total		Count	12	5	3	6	7	16

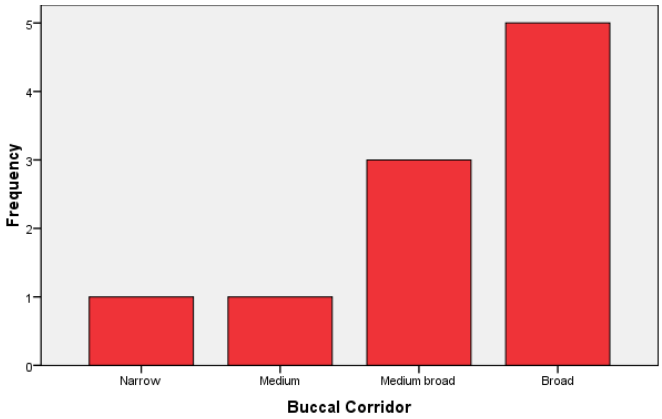
*Percentages and totals are based on respondents.



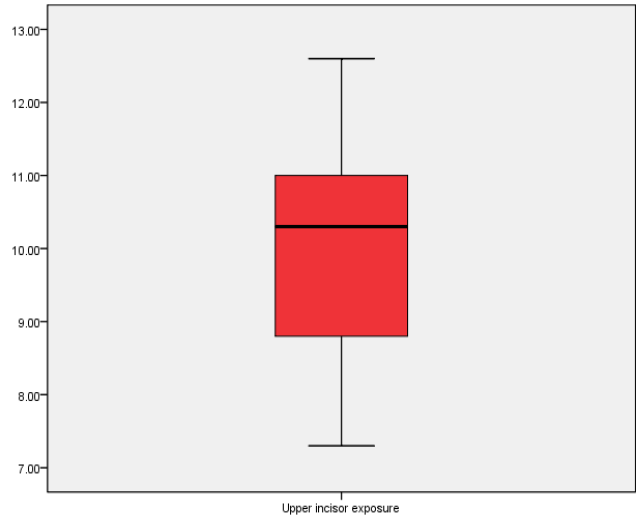
Graph – 1 (Midline - Males)



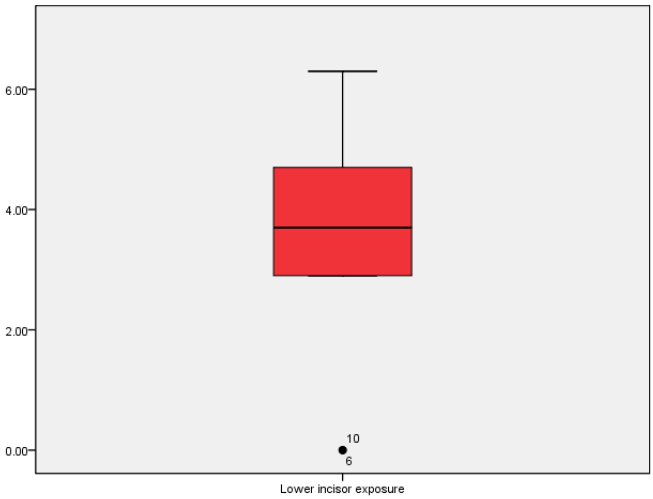
Graph – 2 (Smile arc - Males)



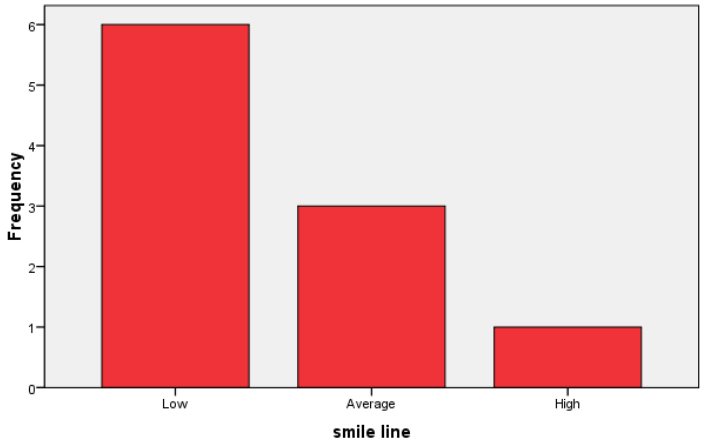
Graph – 3 (Buccal Corridor – Males)



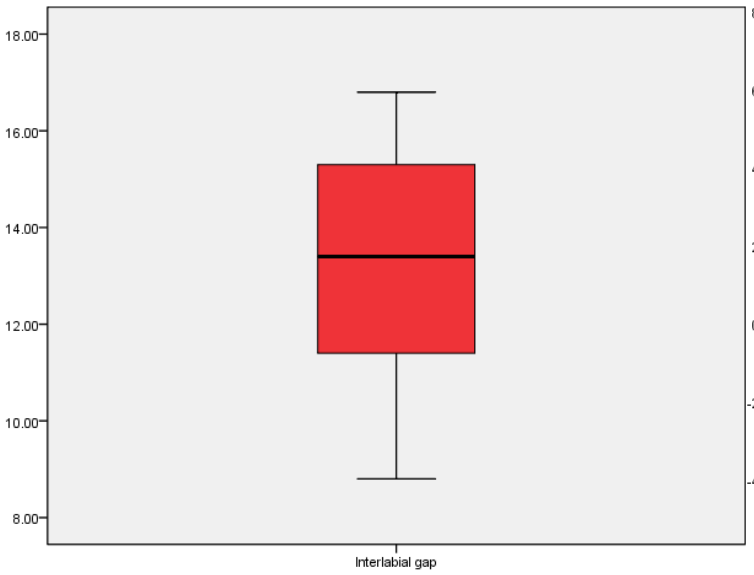
Graph – 4 (Upper incisor exposure – Males)



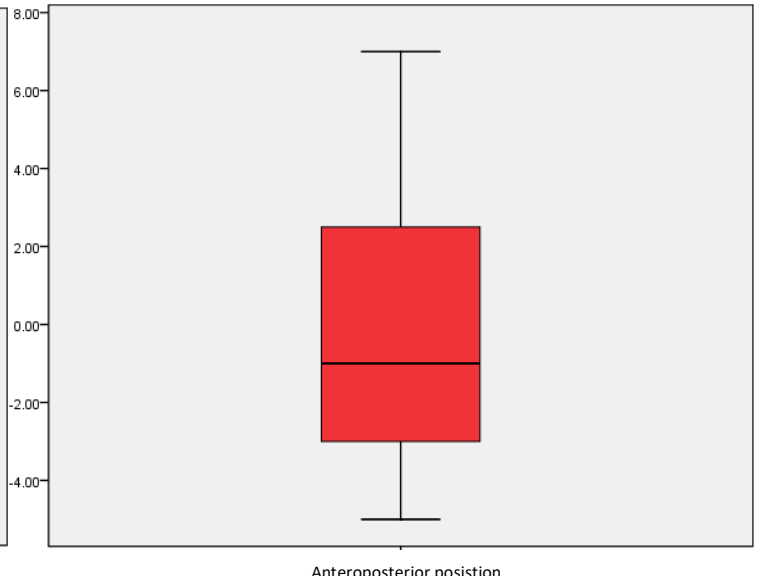
Graph – 5 (Lower incisor exposure – Males)



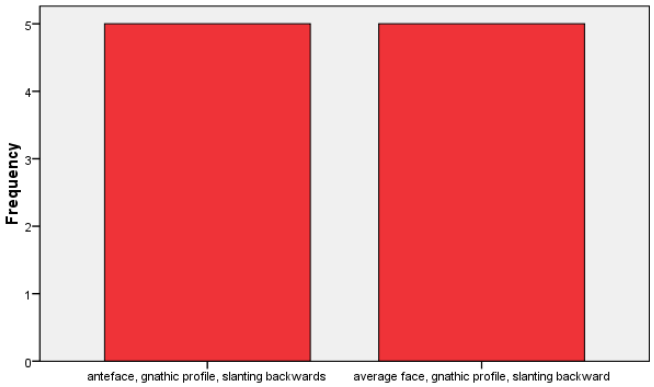
Graph – 6 (Smile line – Males)



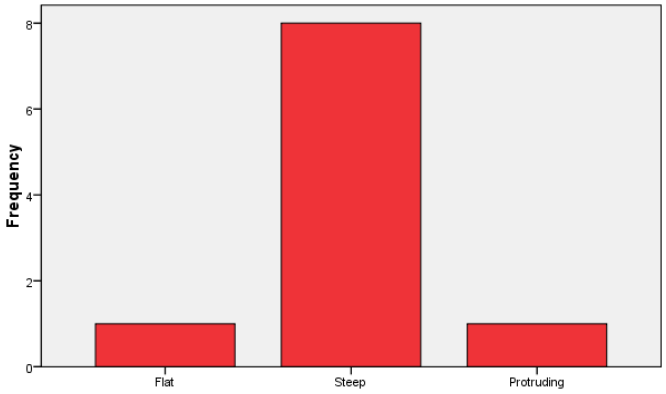
Graph – 7 (Interlabial gap – Males)



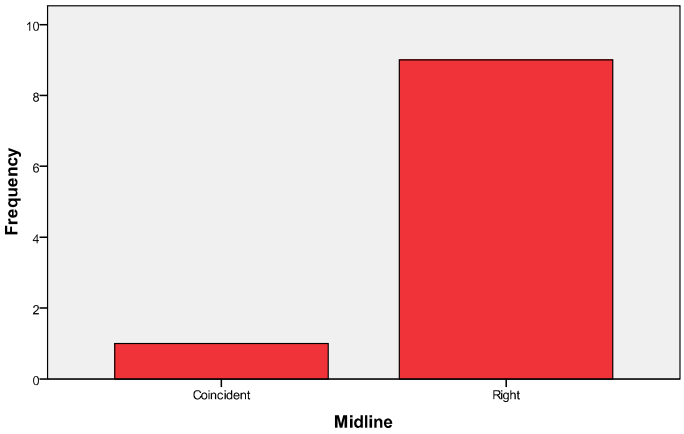
Graph – 8 (Anteroposterior position of upper incisors to forehead)



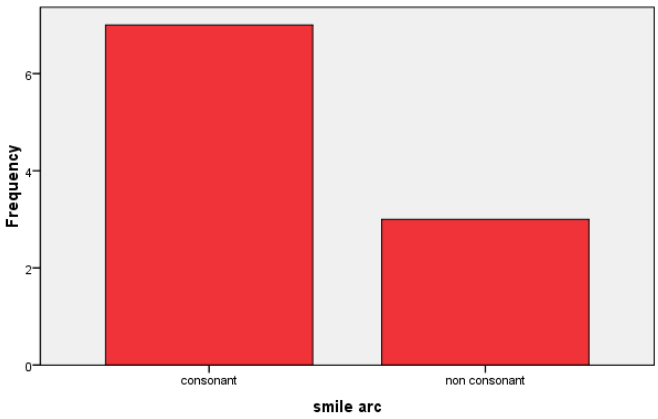
Graph – 9 (Gnathic Profile field – Males)



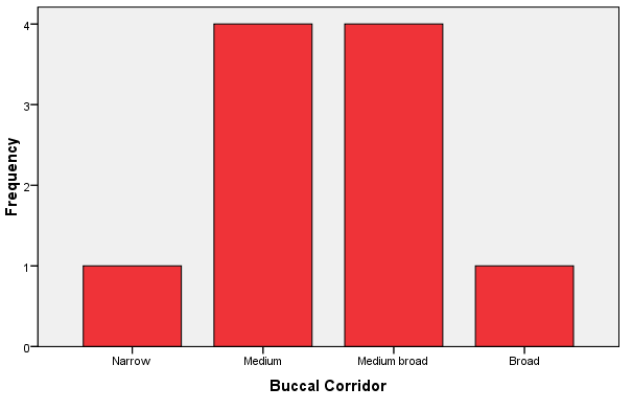
Graph – 10 – Slope of forehead (Males)



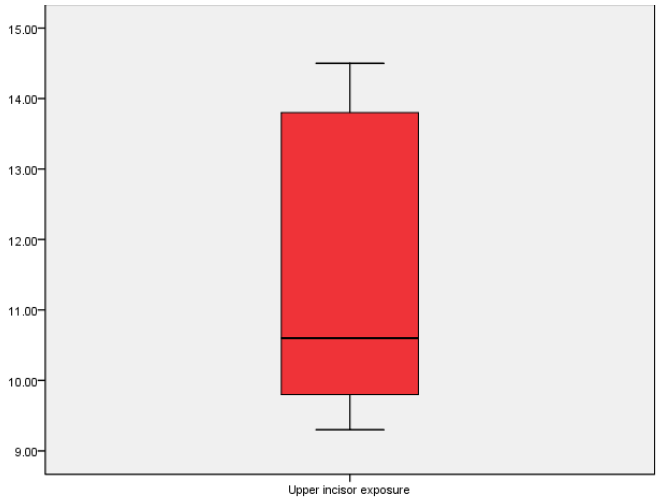
Graph – 11 (Midline – Males)



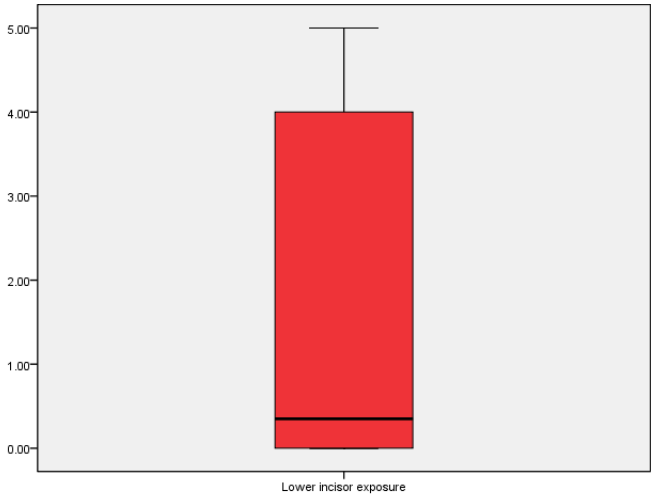
Graph – 12 (Smile arc – Males)



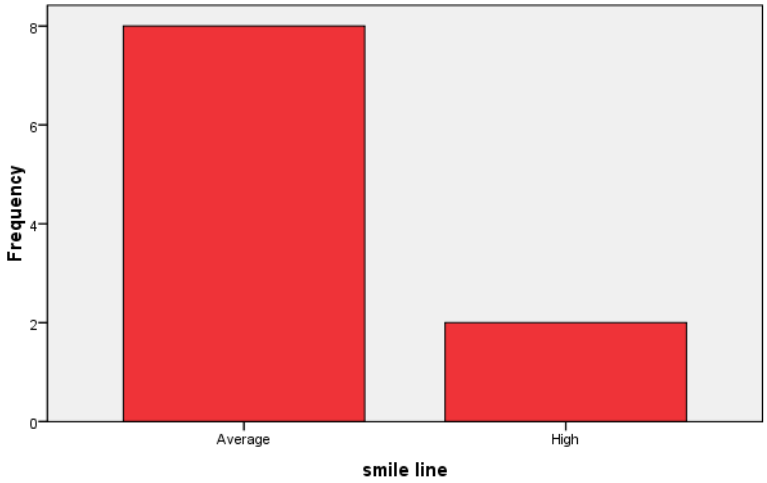
Graph – 13 – Buccal Corridor - Females



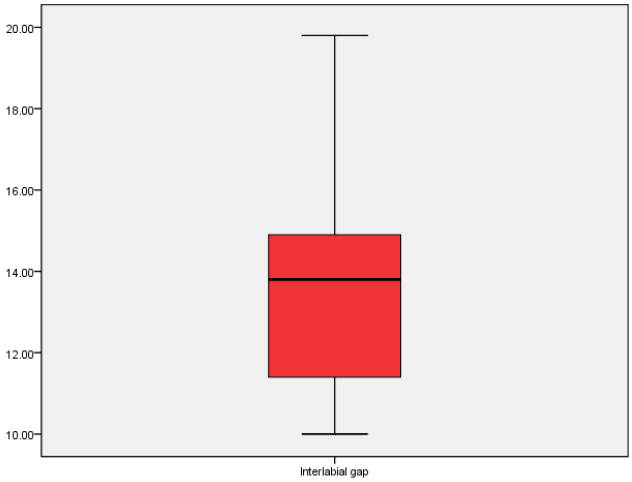
Graph – 14 – Upper incisor exposure – Females)



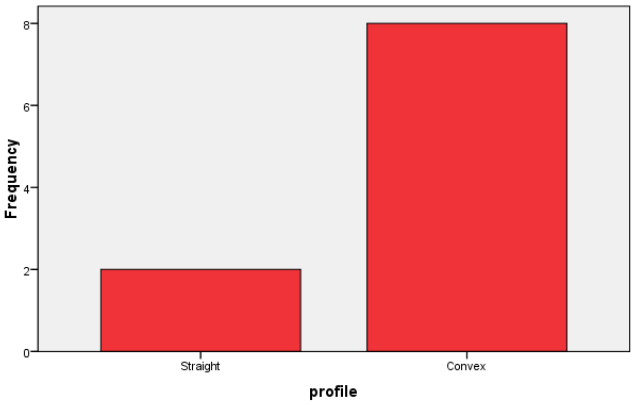
Graph – 15 – (Lower incisor exposure – Females)



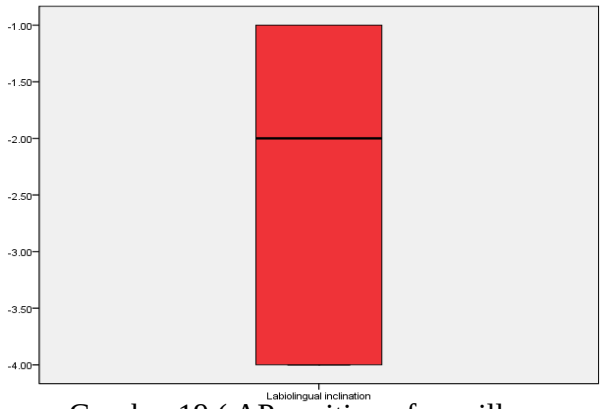
Graph – 16 – (Smile line – Females)



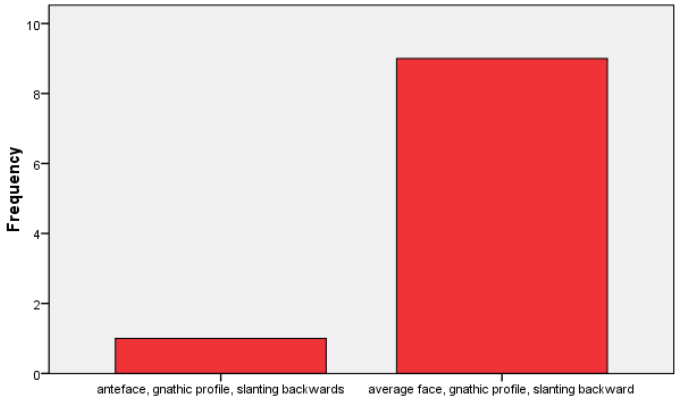
Graph – 17 (Interlabial gap – Females)



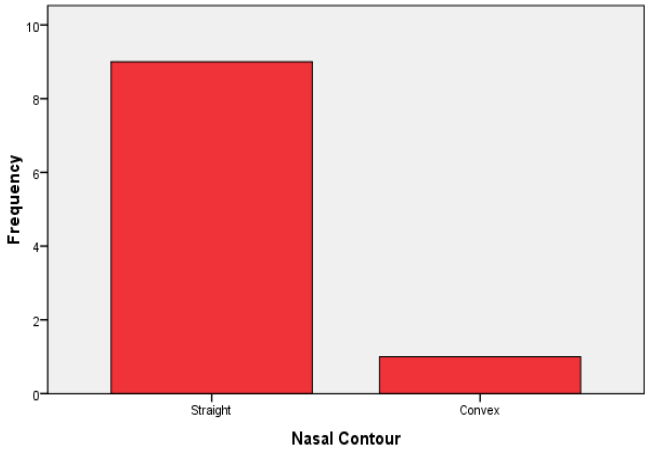
Graph – 18 (Profile – Females)



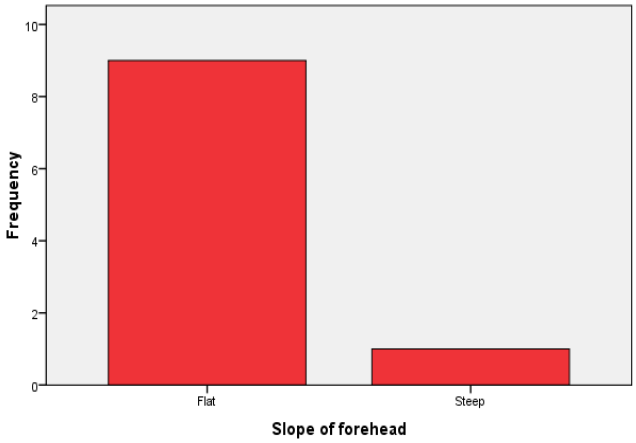
Graph – 19 (AP position of maxillary incisors - females)



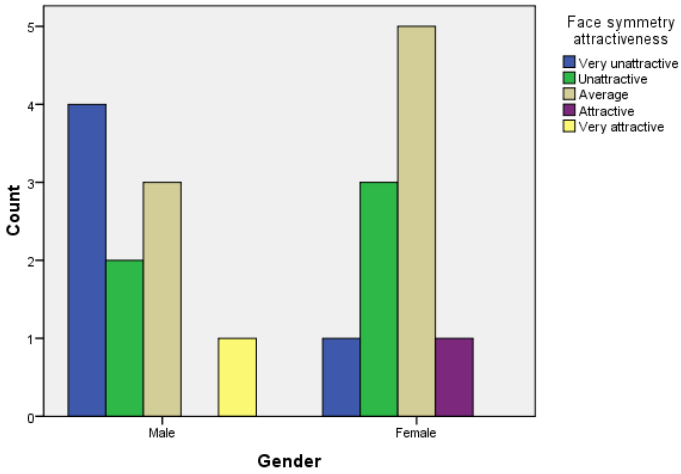
Graph – 20 (Gnathic Profile field – Females)



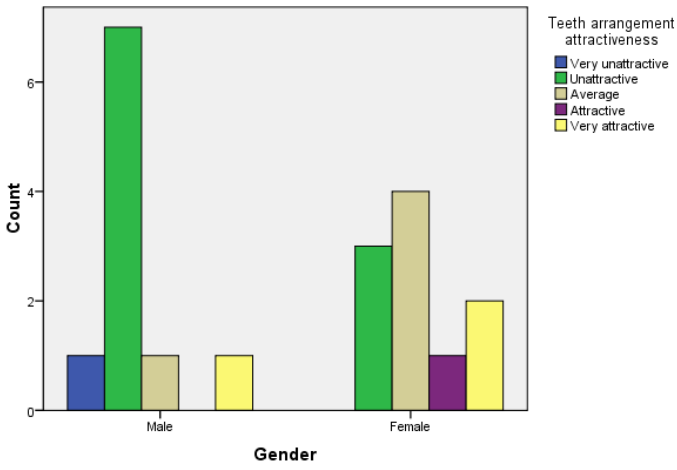
Graph – 21 (Nasal Contour – Females)



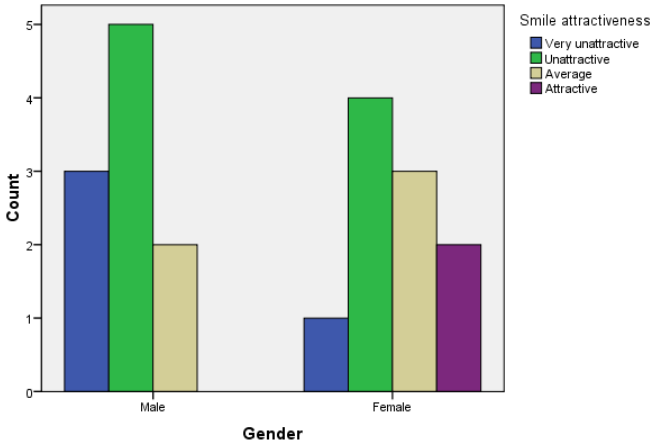
Graph – 22 (Slope of forehead – Females)



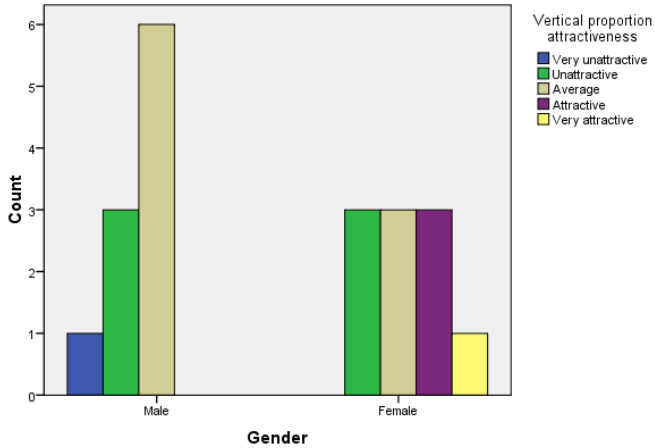
Graph 23 – Facial symmetry



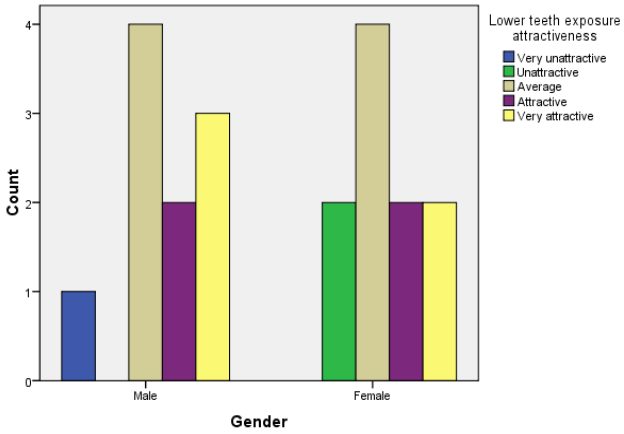
Graph 24 – Arrangement of teeth



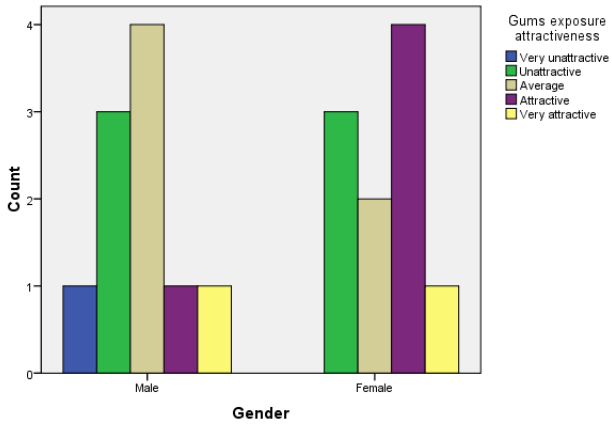
Graph 25 - Smile attractiveness



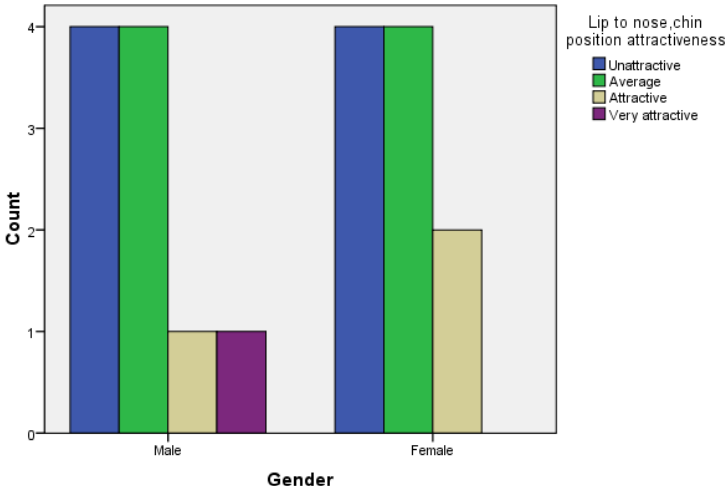
Graph 26 – Vertical proportions of face



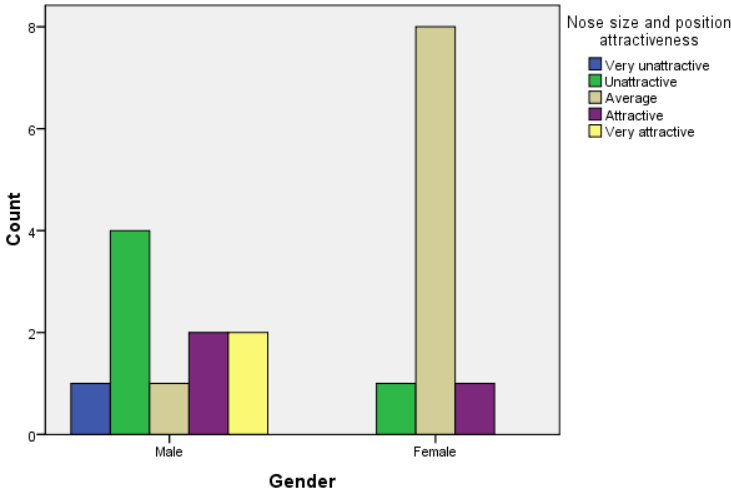
Graph 27 – Exposure of lower teeth



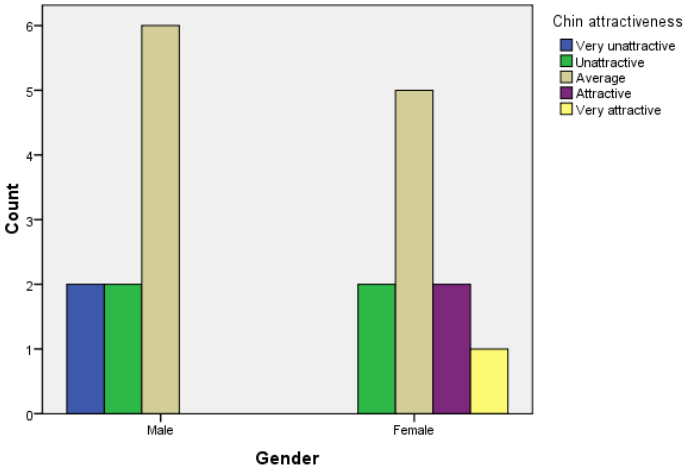
Graph 28 – Exposure of gums



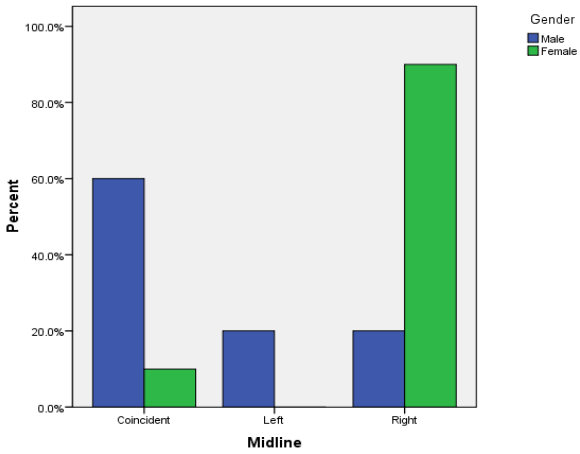
Graph 29 – Lip position



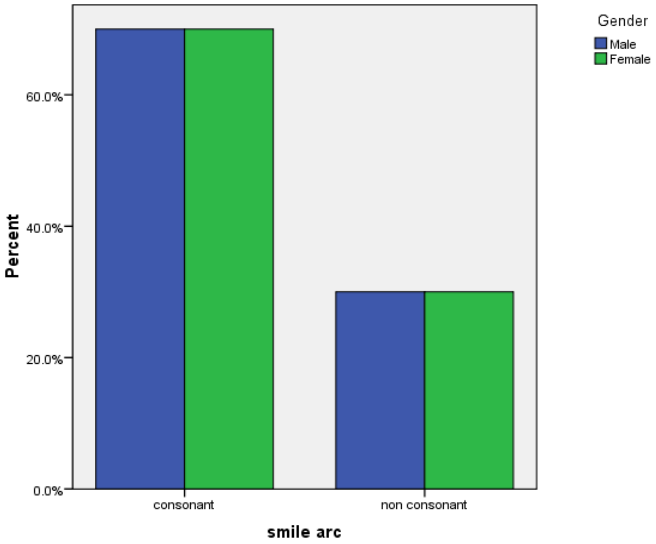
Graph 30 – Size and position of nose



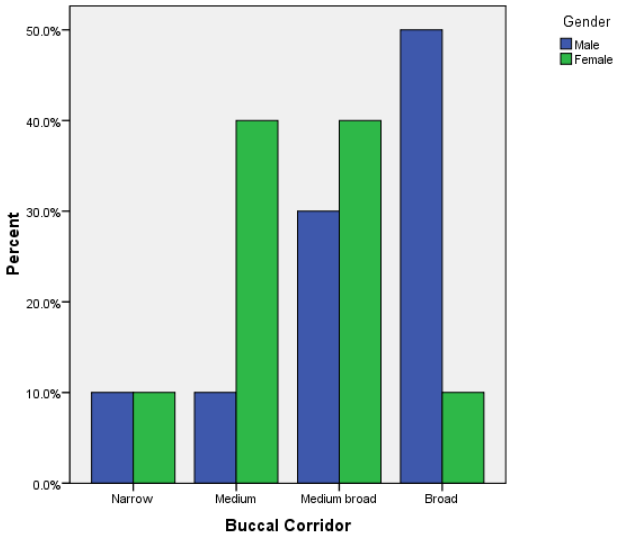
Graph 31 – Chin position



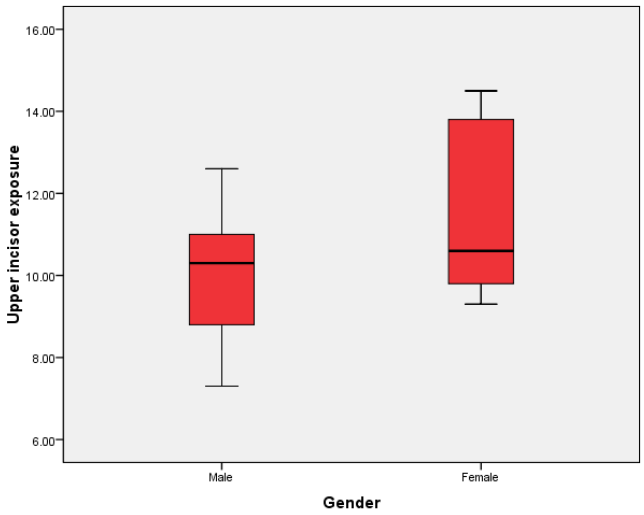
Graph 32 - Midline



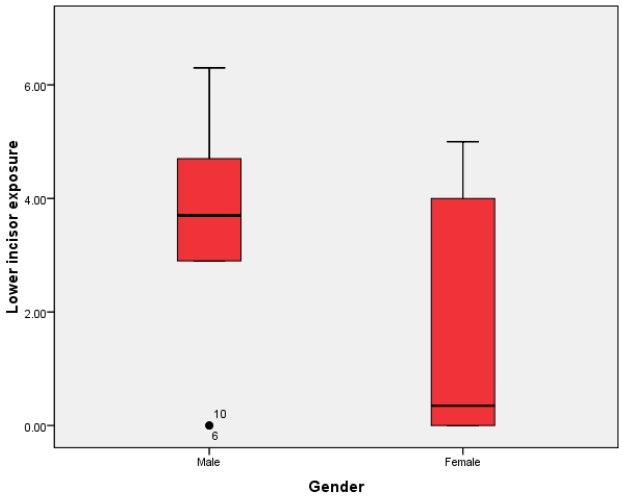
Graph 33 – Smile arc



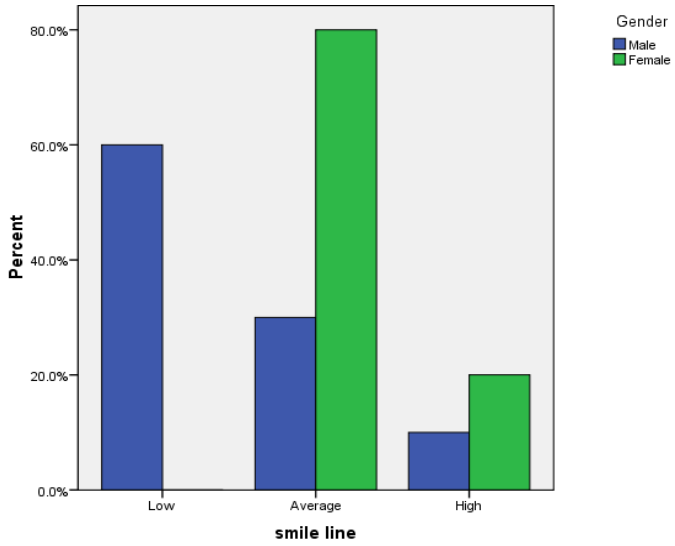
Graph 34 – Buccal Corridor



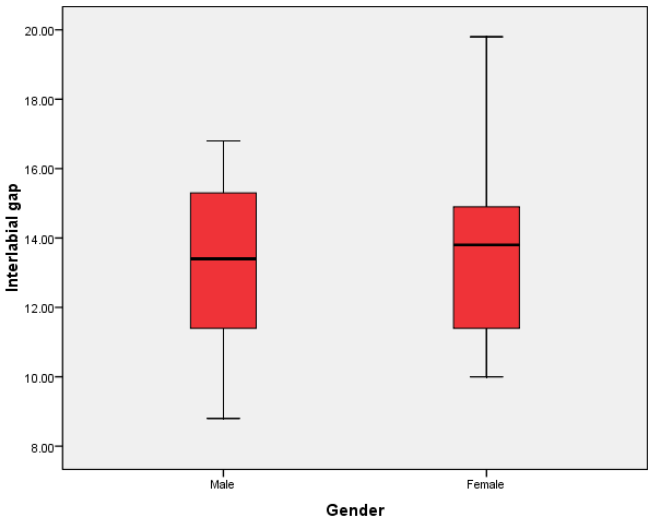
Graph 35 – Upper incisor exposure



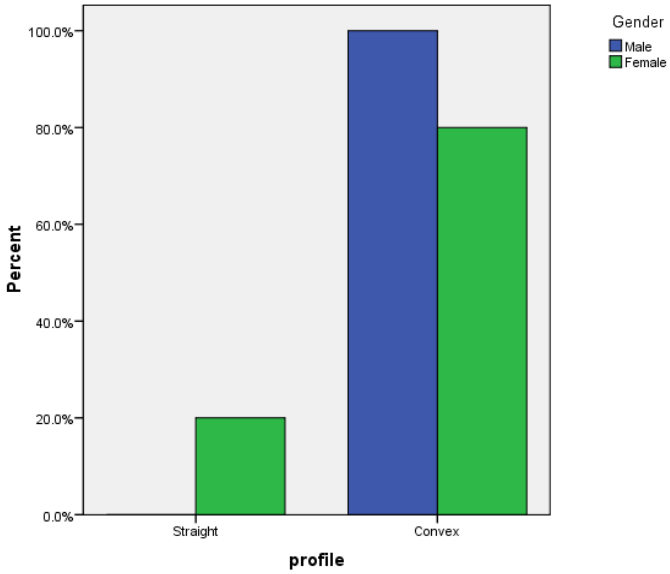
Graph 36 – Lower incisor exposure



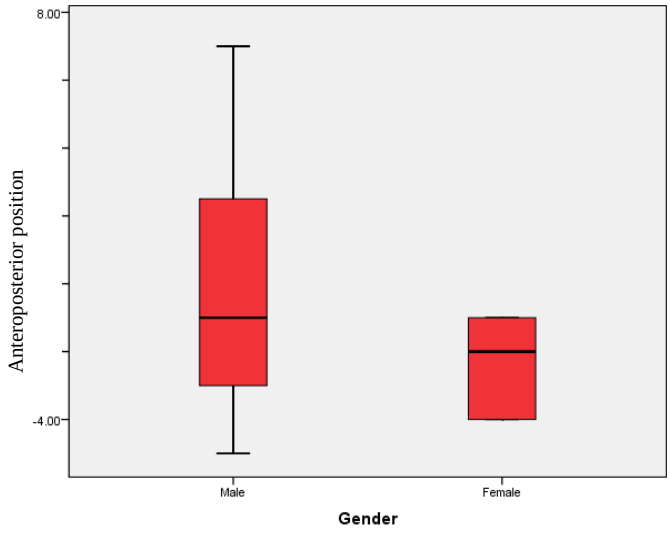
Graph 37 – Smile line



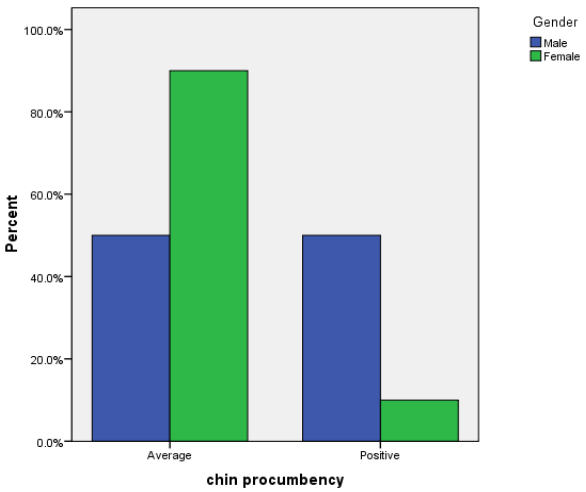
Graph 38 – Interlabial gap



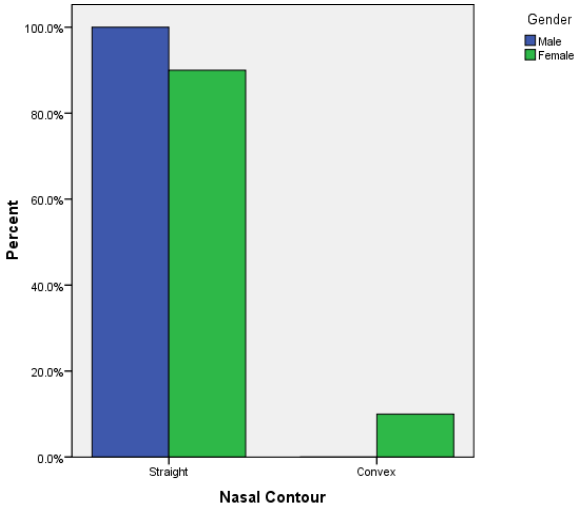
Graph 39 - Profile



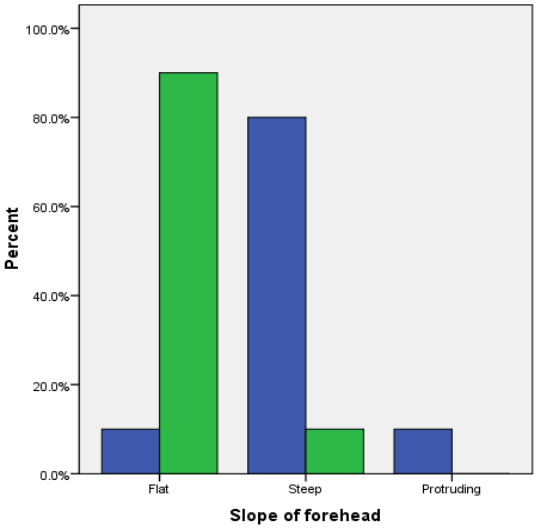
Graph 40 – Antero-posterior position of maxillary incisors to forehead



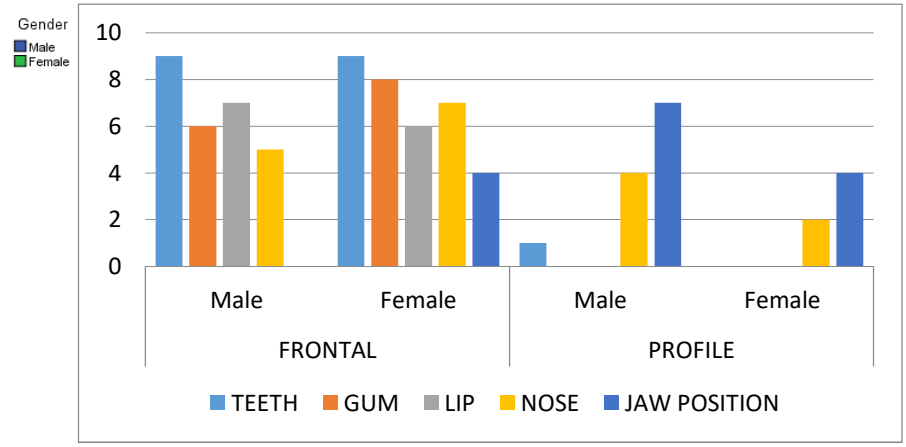
Graph 41 – Position of chin



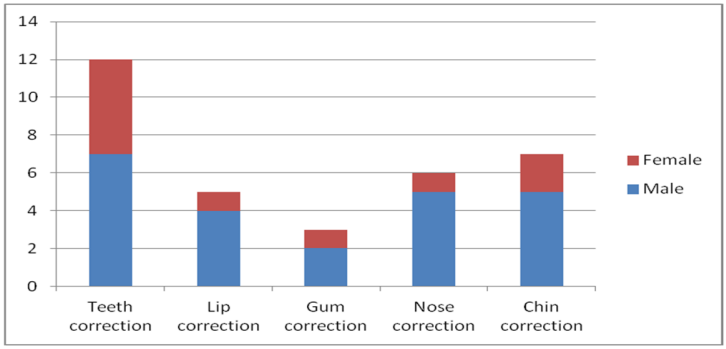
Graph 42 – Nasal Contour



Graph 43 – Slope of forehead



Graph 44 – Preference of structures



Graph 45 – Correction of structures

DISCUSSION

DISCUSSION

"Beauty lies in the eyes of the beholder"; was put forth by Margaret Hungerford in 1878; meaning it is subjective opinion. Hence, it is almost impossible to define the ideal smile because there is much variation in opinion across individuals, ages, cultures and civilizations.[80]The emergence of esthetic paradigm has resulted in greater emphasis on facial attractiveness. The "art of smile" lies in the Orthodontists ability to recognize the positive elements of beauty in each patient and to create a plan to improve those that fall outside the parameters of the prevailing esthetic concept.[21] Facial attractiveness and smile attractiveness appears to be strongly correlated to each other.[7] The reason being, in social interaction, ones attention is mainly directed towards mouth and eyes on the speakers face. As the mouth is center of communication in the face, smile plays an important role in facial expression and appearance.[81]

In this study, the focus is on smile attractiveness and the interplay between hard, soft tissue components of smile (objective evaluation) and facial attractiveness (subjective evaluation).[9] Dimensional measurements in three planes of space were taken into account to analyze smile attractiveness and relate it to overall facial attractiveness in frontal and profile views.[65] Here, the focus was on dimensional measurements to improve reliability by using standardized photographs and calculating enlargement ratio from the subjects maxillary central incisor width to rule out any magnification errors[42]. None of the studies from past literature has accounted attractiveness of posed smile in these two views to find a correlation between subjective opinions and objective measurements.

In this study, 20 samples were equally divided into 2 groups based on gender. This study was undertaken with the aim of relating smile esthetics in all three planes of space to overall facial attractiveness. Proper standardization procedures were followed. The video recording was

uploaded to Gretech Online Movie Player (GOM) software. Quantification was carried out on photos in both the views using SmileDesignerPro software, Microsoft Office PowerPoint – 2013 version and subjective analysis was carried out using a questionnaire for self-perception of facial attractiveness.

In this study, **objective assessment of dental midline relative to the facial midline** showed that midline was shifted to right for 90% of females **(Table-13, 14; Graph 11).** Among males, 20% each had their midlines deviated to right and left respectively. **(Table 2, 3; Graph 1). Chris D. Johnston et al**[82], aimed to identify the threshold where dental to facial midline discrepancy begins to impair dentofacial esthetics. Findings of their study summarized that patients were judged to be less attractive as the size of discrepancy between dental and facial midlines increased, midline discrepancies of less than 2mm appear to have a less noticeable impact on facial esthetics and although many factors are considered while treating a malocclusion, the results of their study indicated that discrepancies of 2mm or more had a negative effect on facial esthetics. In my study, 70% of subjects had their midlines deviated, this could be attributed to the inclusion of IOTN Grade 3(dental health component) samples and also because all the samples had their golden proportions of teeth disproportionate.

In my study, **objective assessment of golden proportion of teeth** showed that it was disproportionate for all the samples (males and females). This could be attributed to the fact that the samples included in the study were chosen based on IOTN Grade 3(Dental health component – i.e. those with moderate requirement of treatment). In a first, study by **Ricketts R M**[82] claimed that the analysis of a physically beautiful face should be approached mathematically, and he advocated the use of golden proportions in that respect. It was reviewed by **Laxmikanth et al**[80] that golden proportion is a geometric proportion which is thought to be the most esthetically

pleasing to the eye. For appreciation of beauty, it has been suggested that the human mind functions at the limbic level in attraction to proportions which is in harmony with the golden section. This divine proportion is the ratio of 1:1.618. It aids the orthodontists in determining the area which is most out of harmony, balance and hence determines the best approach to achieve "harmonic unity" in aesthetics, which in most instances leads to functional unity and efficiency. The results of my study shows that all the samples had golden proportions of their disproportionate probably due to the inclusion of samples with malocclusion (IOTN Grade 3- dental health component).

In my study, **objective assessment of smile arc** showed that for males and females, 70% had consonant smile arc **(Table-3, 4, 14, 15; Graph-2, 12).** In a study done by **Parekh et al[25],** they concluded that significantly greater attractiveness ratings were found for smiles with consonant smile arcs than flat smile arcs. Hence comparing the results of the above study to mine, it can be inferred that 70% of my sample population were attractive since they had consonant smile arcs.

In my study, **objective assessment of buccal corridor** showed that among males, 50% had broad, 30% had medium broad, 10 % each had medium and narrow buccal corridor **(Table 3, 5; Graph 3).** Among females, 40% had medium and medium broad, 10% each had narrow and broad buccal corridor respectively **(Table 14, 16; Graph 13).** In a similar study done by **Hideki Ioi[37],** et al, they studied the influence of the size of the buccal corridor on smile esthetics and proposed a narrow to medium-broad buccal corridor (10% to 15%) as a threshold for esthetic smile evaluations. Hence comparing the results of their study to mine, it can be inferred that females had more esthetic smiles than males because 50% of the females had narrow to medium broad buccal corridors whereas 50% of males had broad buccal corridor.

In my study, **objective assessment of mean values of upper and lower incisor exposure** reveals that females had greater upper incisor exposure(11.4mm) than males(10.14mm) and males had greater lower incisor exposure(3.34mm) than females(1.73mm) **(Table – 30, 31, 32; Graph – 35, 36).** The results obtained here concurs with that done by **Vig RG et al**[85] in which they found similar observations with mean value of upper incisor exposure for females as 10.5+/-2.1mm and males as 9.8mm+/-2.2mm depicting that females had more upper incisor exposure than males.

In my study, **objective assessment of smile line showed that** among males; 60% of samples had a low smile line, 30% had average smile line and 10% had high smile line **(Table 3, 8; Graph 6).** Among females, 80% had average smile line and rest 20% had high smile line **(Table 14, 17; Graph 16).** In a study conducted by **Van der Geld P**[7] it was found that smile line which was positioned such that the teeth were entirely displayed and some gingiva [average smile line - (2 to 4 mm)] were regarded as the most esthetic. Hence it can inferred from my study that females had more esthetic smiles than males because 80% of females had average smile line.

In my study, **objective assessment of interlabial gap** showed that males had a mean interlabial gap of 13.37+/-2.462mm and females had a mean value of 13.63 +/-2.833mm. It can be seen that in this group of samples, females had more interlabial gap than males **(Table 9, 34; Graph 38).** In a study done by **Weeden et al**[86], they concurred that the increase in interlabial gap could be due to greater amount of facial movements during smiling. Hence when comparing the results of their study to mine; it can be inferred that females had more facial movements than males which resulted in a greater interlabial gap than males.

In my study, **objective assessment of mean values of AP relationship upper incisor to forehead** shows that females and males had their maxillary central incisors positioned posterior to foreheads FFA point. **(Table – 36, 37; Graph – 40).** However, results of my study shows that

females had their maxillary central incisor positioned behind foreheads FFA point to a greater extent than males. The results of my study concurs with that done by **Will Alan Andrews**[72] in which he found that 64% of his sample population had maxillary central incisors positioned posterior to foreheads FFA point. The findings from this study can be used for routine orthodontic records diagnosis and treatment planning. The addition of a smiling profile photograph with the forehead and maxillary incisors fully bared to diagnostic records and clinical evaluation will allow the orthodontist to document the orientation of the patient's maxillary central incisors to forehead. Treatment goals should include the condition that maxillary central incisors be positioned somewhere at or between foreheads FFA point and glabella and correlated with foreheads inclination. Andrews proposed to use forehead as a reference to position maxillary incisors since it is external and does not move during the course of treatment.

In my study, **objective assessment of Gnathic profile field** showed that 90% females had an average face, gnathic profile, slanting backward **(Table - 2, 19; Graph 20)** and for males it was non – significant with 50% each having average face, gnathic profile, slanting backward and anteface, gnathic profile, slanting backward **(Table – 3,11 ; Graph 9). Hönn M. et al**[87] in their study concluded that straight average face was perceived as most attractive, followed by moderately retrognathic, as well as mildly prognathic profile lines. The results of my study shows that 70% of samples had average face, gnathic profile, slanting backward; hence according to aforementioned study, it could be concluded that 70% of samples were attractive.

In this study, **objective assessment of slope of forehead** for males showed 80% of male's had a steep forehead **(Table – 2, 12; Graph 10)**. For females, 90% had a flat forehead **(Table – 2, 21; Graph 22).** In a smiliar study done by **Farkas and Kolar**[88] they had stratified patients based on facial attractiveness and concluded that very attractive patients had flat or protruding forehead

types whereas as those with steep forehead was considered less attractive. Their results were used to stratify attractive samples based on slope of forehead in my study and it can be concluded that females are more attractive than males as they had a flat forehead relative to males who had a steep forehead. In a dissimilar study done by **Heidi S. Ellis**[89] et al, they had simulated a forward or backward movement of the forehead and kept the lower one third of face in its original and most natural position, and assessed to determine if changes in the anteroposterior position of a patient's soft tissue glabella affects the evaluators subjective ratings of facial attractiveness. The results of their study suggested that changes of AP position of the soft tissue glabella does impact the appreciation of facial attractiveness, they attributed this to the fact that the ethnicity of evaluators or judges can influence the perception of esthetics and another possible explanation was that the samples had make-up applied for the photo and a few other samples had blemishes and other distractions.[90]

In my study, **subjective evaluation for relationship of arrangement of teeth to overall facial attractiveness** showed that among males, 70% had rated arrangement of teeth as unattractive **(Table – 22, 23; Graph – 24).** Among females, 40% rated arrangement of teeth as average **(Table 24, 25; Graph - 24)**. **Langlois JH et al**[91] had described the concept of averageness. He said that averageness can be considered as attractive. Averageness has been demonstrated in various studies to be a preferred design, but may even concede that beauty goes beyond being merely more attractive and in fact, differs in important ways from being simply average. Hence those who had rated their subjective evaluations as average were considered as attractive in my study. 55% of samples in my study rated their teeth arrangement as unattractive, which could be related to inclusion of malocclusion samples (IOTN Grade 3- dental component).

In this study, **subjective assessment of relationship of smile to overall facial attractiveness** showed that among males, 50% of samples rated their smile as unattractive, 30% of samples rated their smile as very unattractive and 20% rated their smile as average. Among females, 40% rated their smile as unattractive, 30% rated their smile as average, 20% rated their smile as attractive and 10% rated their smile as very unattractive. **(Table – 40, 41; Graph 46).** The results of my study showed that 65% of samples had rated their smile as unattractive possibly due to the inclusion of samples with malocclusion and also due to the fact that all samples had golden proportion of teeth; disproportionate.

In this study, **subjective assessment of relationship of size and position of nose to overall facial attractiveness** showed that for females, 80% had rated size and position of their nose to overall facial attractiveness as attractive **(Table – 24, 25; Graph – 30)** and among males 50% each rated it as unattractive and attractive respectively **(Table 22, 23; Graph – 30).** It can be understood that there was a biased opinion based on gender while relating the subjective perceptions of relating the size and position of nose to facial attractiveness.

In my study, **comparison of objective evaluations between groups** depicted that the dental midline relative to the facial midline was deviated to right for 55% of samples **(Table – 26, 27; Graph – 32). Chris D. Johnston et al**[92] summarized that patients were judged to be less attractive as the size of discrepancy between dental and facial midlines increased. This could be the possible reason why the samples chose their teeth arrangement as unattractive.

In my study, **objective assessment of profiles** depicted that 90% of samples had a convex profile **(Table – 35, Graph – 39)**. In a study done by **Spyropoulous and Halazoneti**[93]**,** it was depicted that even after the profile photos were warped to produce a different outline shape, there was no significant variability in attractiveness; and concluded that other factors might contribute

more significantly to facial attractiveness than just the profile outline shape. **Ronald J. Mackley**[94] stated that profile cannot be used as a reliable source of information to determine what a person's actual smile looks like. However assessment of profile can be used for diagnostic purposes, particularly to identify patients with severe disproportions[70]. Hence it can be concluded that 90% of samples included in my study had Class II skeletal pattern since they had convex profiles.

In my study, **subjective evaluation to determine the order of preference of best viewable structure from frontal and profile view** was done in order to obtain an insight into the structures influencing the decision of facial attractiveness and the results depicted that 90% of samples felt that teeth was the best viewable structure from the frontal view; and 55% of samples felt that position lower jaw was the best viewable from the profile view. A study done by **Shaw et al[95];** hypothesized that adolescents with normal dental appearance would be judged to be more socially attractive than others. The results of my study, concurs with the results of the former study in such a way that the sample population of my study had also considered appearance of teeth; the most important while analyzing facial attractiveness on the whole. In another study done by **Maple et al[28]**; they altered the position of lower jaw in 4-mm increments and found that when the anteroposterior position of lower jaw was modified, the farthest the deviation from Class I, the lesser the profiles were perceived attractive. Hence when comparing the results of the aforesaid study to mine, it depicts the importance of position of lower jaw in profile view and shows the importance of keeping orthodontic norms in mind for diagnosis and treatment planning.

In my study, when the **subjects were asked regarding their choice of treatment for correction of facial structures in order to improve attractiveness;** it was seen that, 75% of subjects had opted for correction of teeth which could possibly be due to the inclusion of samples with malocclusion (IOTN-Grade 3-Dental health component). This is in accordance with the study

done by **Havens et al**[10]**,** who reported that arrangement of teeth is a more important factor for evaluating facial esthetics. Therefore, contemporary orthodontists must consider esthetic smiles by managing the dentition and soft tissues.

According to a study conducted by **Mohan et al**[45] they mentioned that it is of prime importance that the final outcome of orthodontic treatment is not entirely dependent on looks alone. The ultimate goal is to achieve a pleasing composition in smile, by creating and arrangement of various esthetics elements.

The results of my study concurs with that done by **Schabel et al**[9], in such a way that not all objective attributes of smile assessed, could predict attractive or unattractive smiles as judged subjectively[6]. This could be attributed to the fact that individual perception of smile esthetics is influenced by national/cultural backgrounds which in turn can affect multiple variables in unequal ways[96]. Hence all of these factors are critical and should be considered in research and clinical settings.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

An in vivo study was conducted with the aim of evaluating smile attractiveness in all three planes of space; from frontal and profile view; and to relate it to overall facial attractiveness. A total of 20 samples were included in the study and divided equally into 2 groups based on gender; following which objective and subjective assessments were done. All standardization procedures were carried out and a video of 10 seconds duration was recorded with two cameras, placed at right angles to each other, covering both the views at the same time. The best frame depicting unstrained posed smile was selected for both the views and transferred to SmileDesignerPro software and quantification was done for objective assessments. A questionnaire together with a template consisting of photographs in frontal and profile view were distributed to the samples for assessing facial attractiveness subjectively. Intra group and inter group comparisons were carried out for both the views based on gender; separately for objective and subjective assessments.

At the end of my study, after finalizing the results statistically, I would like to conclude that;

1. In the profile view, in sagittal plane of space;

a. 50% of males and 40% of females had related the findings of **gnathic profile field** to be unattractive, because the samples had a class II skeletal pattern.

b. All males and 95% females, had a straight nasal contour, in spite of that, 50% of males had related, **nasal contour** to overall facial attractiveness as unattractive and 80% of females had rated it as average.

c. 80% of males had a steep **slope of forehead** and 90% of females had flat forehead depicting that females were more attractive than males.

d. 70% of males and 40% of females selected **chin** as the best viewable structure from profile view to assess overall facial attractiveness.

e. The **antero-posterior relationship of maxillary incisors** to forehead, as indicated by Goal anterior limit line, revealed that females had more retroclined incisors than males.

2. In the frontal view, **in transverse plane of space;**

a. All samples had disproportionate, **golden proportion** of their teeth, indicating irregular arrangement of teeth, when viewed from frontal view. 70% of males and 50% of females felt, the **arrangement of teeth** to be unattractive, when related to overall facial attractiveness.

b. 80% of males and 50% females had rated their **smile** as unattractive despite of 70% of males and females having consonant **smile arcs**.

c. 90% of males and females had selected **teeth** as the best viewable structure from frontal view to assess overall facial attractiveness.

d. 50% of males had broad **buccal corridor** and 40% of females had medium buccal corridors depicting that females had more attractive smiles than males.

3. **In the frontal view, in vertical plane of space;**

a. 60% of males and 30% of females felt that **vertical proportions** of their faces were unattractive since all the samples had vertically disproportionate face.

b. 40% of both males and females had related **exposure of lower teeth,** averagely to facial attractiveness.

c. In objective findings, 30% of males and 80% of females had an average **smile line**; but subjectively, 80% males and 70% females rated their smile to be unattractive.

d. The mean values of **inter labial gap** for females were more than males, and 40% of both the genders, rated their lip position as unattractive and only 20% of both the genders found it attractive.

3. 77.8% of males and 71.4% of females had opted for **correction of their teeth** to improve their overall facial attractiveness.

Several areas discussed in this study that requires further explanation could include the development of a more comprehensive scale for measuring facial attractiveness, increasing the number, types of samples and raters to represent varied ethnic backgrounds, socioeconomic status, and age groups which would enable the results to be generalized to other populations. With the use of modern technology including 3- dimensional imaging and animation one can broaden the study of perception of facial attractiveness. These aforementioned points should be considered as determining factors in the future, for more comprehensive studies.

The structures assessed in this study are often overlooked in orthodontic treatment planning. These structures should not be considered as rigid boundaries, but as artistic guidelines to help orthodontists, treat patients to improve their overall facial attractiveness.

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